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ERRATA.

Page 18 7 lines from end for " Jörg (M. G.) " read " Jörg (M. E.) "
,, 69 line 8 for " *pallidipes* " read " *pallidipennis* "
,, 116 line 19 for " Shute (P. C.) " read " Shute (P. G.) "
,, 133 9 lines from end for " 1940 " read " 1939 "
,, 138 13 lines from end for " *Mazzama* " read " *Mazama* "
,, 183 10 lines from end for "*A. pseudopictus*" read "*A. h. pseudopictus* "
,, 193 line 14 for " Fröhl." read " Fröl."
,, 257 line 6 for " *Listophorus* " read " *Listrophorus* "

IMPERIAL INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES B.

VOL. 28. 1940.

DE BURCA (B.). **Note on Anti-malaria Measures in Quetta Cantonment during 1938.**—*J. Malar. Inst. India* **2** no. 2 pp. 121–130, 4 pls., 1 map, 2 charts, 6 refs. Calcutta, 1939.

An account is given of the anti-mosquito measures employed and the organisation of the anti-malaria work in Quetta Cantonment in 1938, together with the results of adult and larval Anopheline surveys. The information given by Mulligan & Baily [*R.A.E.*, B **24** 258] was concerned chiefly with mosquitos taken outside the cantonment. Of 7,735 Anophelines identified, 89 per cent. were *Anopheles superpictus*, Grassi, 6 per cent. *A. turkhudi*, List., 2 per cent. *A. culicifacies*, Giles, and 1·4 per cent. *A. stephensi*, List. ; a few other species were taken in small numbers. *A. superpictus* was the only malaria vector abundant enough to be of importance in transmission, as *A. turkhudi* is thought not to be a vector in Quetta. The fact that most of the mosquitos found in the cantonment breed outside its limits might explain the relative prevalence of *A. superpictus*, which is a large mosquito with a longer range of flight than *A. culicifacies* or *A. stephensi* ; in one area rather large numbers were taken in July, and a search showed that the nearest breeding place was 1½ miles distant. Among 2,643 mosquitos collected outside the cantonment, however, *A. superpictus* was again the commonest species, and *A. culicifacies* was very scarce. No explanation was found for the extraordinarily small numbers of the latter species, which had been so prevalent in previous years [*cf. loc. cit.*]. Anopheline larvae were first observed outside the cantonment in May and were most abundant about the end of August, whereas they were not seen in the cantonment until July.

Only 13 breeding places were found in the cantonment, and Paris green was used only on the Hanna irrigation stream and the Durani nullah, which were the only ones that were important and permanent. Since no breeding was found in stretches of water to which certain fish had access, experiments were undertaken to investigate their possible value in control work. One, *Nemachilus kesslere*, controlled Anopheline breeding in a reservoir near the city during August and September, the other, *Discognathicthys rossicus* var. *nudiventris*, was found to be at least as efficient as *Gambusia*,

which has been used successfully in various reservoirs. A mixture of equal parts of kerosene oil (third quality) and crude oil (first quality) with two per cent. cresol and one per cent. castor oil proved very effective as a larvicide and was surpassed by malariol only in the speed with which the latter killed the vegetation, which could in any case be removed more cheaply by coolie labour. A pyrethrum extract (Pyrocide 20) diluted with kerosene (1 : 19) gave good results; only a small quantity was required, and the larvae were killed very rapidly. All barracks were sprayed with the same diluted extract once a week during the early part of the season and at least twice a week during August and September, and this measure is believed to have been responsible for much of the marked reduction in the incidence of malaria that was observed among the troops in 1938. During September there were 43 cases, as compared with 530 for the same month in 1937. Other measures included the use of traps and mosquito nets, and, for sentries, head nets and gloves.

Russell (P. F.) & Jacob (V. P.). **Epidemiology of Malaria in the Ennore-Nellore Coastal Area, Madras Presidency, India.**—*J. Malar. Inst. India* **2** no. 2 pp. 131–152, 2 pls., 2 charts, 15 refs. Calcutta, 1939.

An account is given of investigations carried out in a narrow strip of coastal territory that extends northwards for some 120 miles from Madras City and in which the incidence of malaria is high. The chief crop is *Casuarina equisetifolia*, which grows readily in the sandy, relatively infertile soil, provided that it is watered regularly for two or three years until its roots reach the subsoil water 2–6 feet below the surface. It is grown for firewood and cut every 5–10 years. Shallow wells with a diameter of about ten feet are dug at the rate of at least six, and sometimes many more, per acre, to provide the water, which is carried to the trees in earthen pots. Even the roots are sold for firewood, and sometimes root pits are left and collect water. As soon as one crop is cut another is planted, and the wells are deepened, re-dug or augmented in numbers. In some villages there are coconut plantations, which are generally watered from small reservoirs that may be very numerous and perhaps average less than 25 feet in diameter.

In the course of Anopheline surveys, 27,187 larvae and 7,227 adults comprising 12 species were collected between May 1937 and October 1938. *Anopheles culicifacies*, Giles, and *A. subpictus*, Grassi, which were prevalent throughout the year, were the only species out of 8 subjected to precipitin tests that were positive for human blood and the only ones that were found infected with malaria parasites among the 6,033 examples belonging to 10 species that were dissected. Oöcysts and sporozoites were found in 5 out of 739 and 1 out of 984 females of *A. culicifacies*, respectively, and in 2 out of 4,013 and none out of 4,893 of *A. subpictus*. Collections were made in 12 types of breeding places, but 87·6 per cent. of all larvae were taken in casuarina wells or pits. Larvae of *A. culicifacies* and of *A. subpictus* were found in all the types, but were most abundant in the pits, and the control of malaria in this area appears to be entirely a question of dealing with the latter.

Filarial larvae were found in the thoracic muscles of a female of *A. subpictus* taken in a village in which were persons with elephantiasis

of the legs and in those of two females of *A. culicifacies*; these two mosquitos were taken in a house near which wood-cutters from an island known to be filarious were harvesting casuarina and in two of whom elephantiasis was observed.

CHOPRA (R. N.) & BASU (B. C.). **Studies on the Effect of Anti-malarial Drugs upon the Infectivity of Patients to Mosquitoes. Part III. "Prontosil."**—*J. Malar. Inst. India* **2** no. 2 pp. 153–154, 6 refs. Calcutta, 1939.

In continuation of previous work [*cf. R.A.E.*, B **26** 57; **27** 152], 511 laboratory-bred females of *Anopheles stephensi*, List., were fed on five carriers of gametocytes of *Plasmodium falciparum* before and after treatment with various doses of Prontosil. A high percentage of the mosquitos showed gut and gland infections even after the administration of the highest dose (40 tablets) of the drug. It was also observed that the crescents did not disappear from the blood of the patients after they had received heavy doses.

ROY (D. N.) & SIDDONS (L. B.). **Egg of *A. philippinensis* Ludl.**—*J. Malar. Inst. India* **2** no. 2 pp. 159–164, 3 figs., 1 ref. Calcutta, 1939.

The provisional description of the egg of *A. philippinensis*, Ludl., given by Christophers & Barraud [*R.A.E.*, B **19** 167] was based on eggs from two mosquitos, one of which laid eggs resembling those of *A. annularis*, Wulp, and the other eggs resembling those of *A. maculatus*, Theo. For this reason the authors give descriptions of the eggs of these three species taken in Bengal. They conclude that the eggs described by Christophers & Barraud were not those of *A. philippinensis*.

GILROY (A.). **Health in Tea Gardens of the Darjeeling Terai with special Reference to Malaria.**—*J. Malar. Inst. India* **2** no. 2 pp. 165–179, 2 charts, 2 refs. Calcutta, 1939.

In the section of this paper dealing with Anopheline surveys carried out on tea estates in the Darjeeling Terai, the author classifies the breeding places into those in the north, where many of the smaller streams do not flow during the dry season, the river beds are stony and the currents swift during the monsoon, and those of the south, where the rivers become sluggish, deposit silt and flow permanently between grassy banks. A table is given showing the numbers of each of the 14 species of *Anopheles* caught in the two divisions, and although the numbers of most of them are too small to allow conclusions to be drawn, it is clear that *Anopheles minimus*, Theo., occurs in both areas, whereas *A. aconitus*, Dön., which breeds in rice-fields, is found only in the south. Other tables show the distribution of the species according to the different estates and according to the months from June to November (with the exception of August, when no collections were made), and the numbers of the different species dissected in the same months. Out of 421 females of *A. minimus*, 35 were found infected with malaria parasites, including 6 infections in the salivary glands. The first infected mosquito was taken on 21st October. None of the 126 females of the other species dissected was infected. The difficulty of correlating the incidence of malaria with the presence

of mosquitos in houses is discussed, particularly in view of the rising curve at a time when most breeding places are dry and mosquitos cannot be found in houses by the ordinary methods of collection. It was observed that, however plentiful mosquitos were in coolie dwellings, they were always more numerous in the houses of the sirdars, in which cooking is carried out in detached kitchens and the dwelling quarters are free from smoke.

Strickland (C.) & Roy (D. N.). **Scarabiasis or the Presence of Beetles in the Intestine.**—*Indian med. Gaz.* **74** no. 7 pp. 416–419, 11 refs. Calcutta, 1939.

After briefly reviewing previous records of the occurrence of dung beetles in human faeces in India and Ceylon [*cf. R.A.E.*, B **16** 251, etc.], together with evidence that they live in the intestine, the authors give, in a table, details of 15 further Indian cases in which the beetles were forwarded to them by medical officers. Most of the beetles belonged to the genus *Onthophagus*, though a few were species of *Caccobius* and one an unidentified species of *Saprinus*. In all previous observations, only one species of Coprid has been reported from one case, but these records include one case in which three species and another in which four were concerned. The infestation almost always occurs in children ; it has never been reported from unweaned infants, and only once in an adult. The two hypotheses regarding the mechanism of infestation are discussed [*cf. loc. cit.*] and it is pointed out that, whether it takes place by ingestion or through the anus, it is difficult to explain the reports that patients continue to pass beetles at intervals, sometimes over a period of months.

Soewadji Prawirohardjo. **Infectieproeven mit** *Microfilaria bancrofti* **bij verschillende muskietsoorten in Batavia.** [Infection Experiments with *Filaria bancrofti* in various Mosquitos in Batavia.]—*Geneesk. Tijdschr. Ned.-Ind.* **79** pt. 27 pp. 1691–1705, 1 pl., 9 refs. Batavia, 1939.

To ascertain the vectors of *Filaria bancrofti* in Batavia, the author dissected mosquitos at various periods after they had fed on an infected patient under a mosquito net. Some of these mosquitos were caught after they had entered the net during the night under natural conditions, and some (including all those of genera other than *Culex*) were bred in the laboratory and released in the net during the evening. Mosquitos harbouring filarial larvae were regarded as positive, but the author agrees with Brug that those in which development of the larvae does not occur or is retarded should be regarded as negative [*R.A.E.*, B **26** 162].

Culex fatigans, Wied., *Anopheles sundaicus*, Rdnw. (*ludlowi*, auct.) and *A. subpictus*, Grassi, were efficient vectors. Of 102 reared or captured females of *C. fatigans*, 63 were positive, the larvae developing normally in them. Mature larvae were found in the proboscis after 12–14 days, and retarded development was very exceptional. Normally developed larvae were found 29 times in the head and 8 times in the proboscis. Of 18 females of *A. sundaicus*, 9 were positive, 3 having larvae in the head. The larvae developed normally and no retarded

development was observed. A mature larva was found in the proboscis of a mosquito dissected after 14 days. Of 55 females of *A. subpictus*, 39 were positive, normal development of the larvae being the rule and slight retardation the exception. Larvae were found in the heads of 8 mosquitos after 10–17 days, and a mature larva in the proboscis in 2 mosquitos after 13 and 14 days.

Larvae were found in 4 out of 6 examples of *A. annularis*, Wulp (*fuliginosus*, Giles), 5 of 9 of *A. vagus*, Dön., 4 of 6 of *A. barbirostris*, Wulp, and all of 3 of *A. tessellatus*, Theo., and it is concluded that probably these Anophelines are efficient vectors in Batavia. A larva was found in the head of a female of *A. annularis* after 15 days. The larvae developed normally in *A. vagus*, and a mature larva was found in the proboscis. Larvae were found in the thorax and head in 3 examples of *A. barbirostris* after 15 days, one also having a mature larva in the proboscis. The 3 females of *A. tessellatus* were dissected after 3, 11 and 11 days, and all contained normally developed larvae.

Culex sitiens, Wied., *C. whitmorei*, Giles, and *C. fuscocephalus*, Theo., are probably of little importance in Batavia. Of 34 reared and captured examples of *C. sitiens* with infection periods of 1–25 days, 13 were positive, but the average number of larvae in them was 2, and retarded development was frequent, a sausage form being observed after 19 days. No mature larva was found in the proboscis. Of 10 captured females of *C. whitmorei*, 3 were positive. One had 2 sausage forms in the thorax after 15 days, another a very long sausage form in the thorax after 20 days, and the third 2 mature larvae in the thorax and 2 in the head after 21 days. Thus the percentage of infection was low and the development of the larvae retarded. Of 12 captured females of *C. fuscocephalus*, 3 were positive, with infection periods of 8, 16 and 16 days, the larvae showing retarded development. As regards the last two mosquitos, these results are in contrast to those obtained by Brug in Kabaena [*loc. cit.*].

From the retarded development of the larvae observed in them, the author concludes that *Culex tritaeniorhynchus*, Giles, *C. vishnui*, Theo., *C. gelidus*, Theo,. *C. bitaeniorhynchus*, Giles, *Aëdes albopictus*, Skuse, *A. aegypti*, L., *Armigeres obturbans*, Wlk., *Mansonia annulifera*, Theo., and probably also *M. indiana*, Edw., are of no importance as vectors in Batavia.

HODGKIN (E. P.). **The Transmission of *Microfilaria malayi* in Malaya.**—*J. Malaya Br. Brit. med. Ass.* **3** no. 1 pp. 8–11, 2 refs. Singapore, 1939.

The author discusses briefly the distribution in Malaya of filariasis due to *Filaria* (*Microfilaria*) *malayi*, its vectors, and its control [*cf. R.A.E.*, B **27** 92, etc.]. Though all of the five local species of the subgenus *Mansonioides* of *Mansonia* are potential vectors [**27** 11], the evidence so far obtained suggests that *M. longipalpis*, Wulp, is by far the most important. This is partly due to the fact that it was the most abundant species in the areas in which the transmission of filariasis was investigated, but large numbers of *M. uniformis*, Theo., and *M. indiana*, Edw., were dissected and a much smaller proportion of them found infected. It is pointed out that the interpretation of the results of dissecting mosquitos collected in places where *Macacus irus* is numerous is complicated by the fact that this monkey

harbours a species of *Filaria* that is similar to *F. malayi* in the larval and microfilarial stages and may prove on examination of the adults to be identical with it.

Although *M. uniformis* prefers to breed in water containing *Eichhornia crassipes* [*cf.* **27** 11], it also breeds prolifically where there are other plants, particularly a certain swamp grass, *Isachne australis*. The larvae of *M. annulifera*, Theo., apparently prefer to attach themselves to the roots of *Pistia stratiotes*, a very common water plant, particularly in Chinese fish-ponds. Those of *M. annulata*, Leic., have not been found, but from the distribution of the species it is assumed that it breeds in jungle, though not necessarily only there. The larvae of *M. longipalpis* have been found attached to the fine roots of certain swamp-loving trees. These roots emerge from the soil and float about in the water, which, in such places, is often as much as 3 feet deep. Whether it also breeds in other places is not known, but it seldom breeds with the other three species of which the breeding places are known. For localities in which it is the vector, the author considers that the only means of controlling the disease is to concentrate the population and drain the areas in which they are settled.

WALLACE (R. B.). **The Range of Flight of** *Anopheles maculatus*.—*J. Malaya Br. Brit. med. Ass.* **3** no. 1 pp. 22–32, 2 figs., 1 chart, 1 map. Singapore, 1939.

In the experiments described, batches of *Anopheles maculatus*, Theo., were sprayed with painter's gold dust and liberated among mature rubber trees at various distances from the nearest coolie lines, where catches were subsequently made. The results proved that the adults can fly a distance of $1\frac{3}{8}$ miles, the greatest distance tested, and explain why seasonal waves and epidemics of malaria may occur in areas where oiling of breeding places is carried out up to a distance of half a mile from dwellings. Only small proportions of the adults liberated were caught. If, however, the liberations had been made in areas cleared for replanting, many more would presumably have found their way to the lines, and this would explain the great increase in malaria incidence that occurs on rubber estates where planting and replanting are being carried out beyond the half-mile oiling radius.

WALLACE (R. B.). **Resting Places of Anophelines on an inland hilly Estate.**—*J. Malaya Br. Brit. med. Ass.* **3** no. 1 pp. 33–40, 4 charts, 2 refs. Singapore, 1939.

In May 1938, all cattle were removed from an estate in Malaya, and the effect of this procedure on the prevalence of the various species of *Anopheles* is recorded in charts, which show the numbers of adults caught monthly in the 7 divisions of the estate from June to September 1938 as compared with those caught in the same months in 1937. There was a striking reduction in the numbers of all species except *A. maculatus*, Theo. The numbers of *A. maculatus* caught monthly in the native quarters and the cattle-sheds in June–November in the same two years are shown in tables. The fact that most of the adults were collected from the native quarters indicates their preference for feeding on man, and on this estate the incidence of malaria is correlated with the density of this species.

[NABOKOV (V. A.).] **Набоков (В. А.). Analyse et appréciation des résultats de l'application de la méthode aviachimique à la lutte antilarvaire à l'URSS.** [*In Russian.*]—*Med. Parasit.* **8** no. 2 pp. 165–169. Moscow, 1939.

Considerable improvements in the technique of dusting from an aeroplane with Paris green against Anopheline larvae have been made in the Russian Union in the last ten years, and the effectiveness of the method is now considered to be sufficiently demonstrated. In 1937, breeding places over an area of nearly 12,000 sq. miles were dusted. Experience has shown that dusting from aeroplanes is not economically justifiable under all conditions, but it is an important method of control in peat bogs, rice-fields and cotton-growing areas with a net-work of irrigation ditches, and the only method available in the case of reed beds. A brief programme for further improvements in the organisation of the method is outlined.

[YURCHAK (F. F.) & BOZHENKO (V. P.).] **Юрчак (Ф. Ф.) и Боженко (В. П.). Utilisation des suspensions de poisons pulvérulents dans la lutte antilarvaire.** [*In Russian.*]—*Med. Parasit.* **8** no. 2 pp. 170–176. Moscow, 1939. (With a Summary in French.)

In eastern Kazakstan, dusting against Anopheline larvae is often ineffective owing to wind, it is difficult to obtain sufficient quantities of suitable carriers for the dust, and oiling is too expensive. Field experiments were therefore carried out near Semipalatinsk, in which pools of water about 3 ft. deep, covered with vegetation and containing numerous larvae of *Anopheles maculipennis*, Mg., were sprayed with aqueous suspensions of calcium arsenite or Paris green that had been mixed with small amounts of kerosene or crude oil [*cf. R.A.E.*, B **24** 289]. It was found necessary to add enough water to apply about 14 gals. per acre of surface to be sprayed, as if less is used, it is difficult to obtain an even distribution. The numbers of larvae present in the breeding places were estimated by taking sample dips before spraying and 1–3 days after it. Applications with a knapsack sprayer of suspensions in which Paris green was used at the rates of 0·5, 0·7 or 0·9 lb. per acre gave 99·86, 100 and 100 per cent. mortality of the larvae. Calcium arsenite similarly applied at rates of 0·5–2·25 lb. per acre gave average mortalities of from 93·1 to 96·3 per cent. It is concluded, therefore, that spraying with Paris green can be successfully substituted for dusting, and that calcium arsenite, which is less effective owing to its greater solubility in water, can be used if Paris green is not available.

Spraying with aqueous suspensions of calcium arsenite without oil [*cf.* **27** 232] gave only a low mortality. The addition of kerosene or crude oil prevents the dust from sinking ; when applied alone at the rates used for the suspensions (0·75–1·5 pints in 14 gals. water per acre) they showed no toxicity. A water suspension of Paris green was, however, effective against larvae of *Aëdes* and *Culex*, and gave complete mortality, in one instance 4 hours after spraying, when the poison was applied at the rate of 1·3 lb. per acre [*cf.* **26** 112]. This method is considerably cheaper than oiling. Spraying with a suspension of calcium arsenite at the same rate killed only 80–82 per cent. of the larvae.

[Danilova (M. I.) & Buduimko (F. A.).] **Данилова (М. И.) и Будымко (Ф. А.). Essai d'utilisation de l'acidole dans la lutte antilarvaire.** [*In Russian.*]—*Med. Parasit.* **8** no. 2 pp. 177–178. Moscow, 1939.

In the summer of 1938, laboratory and small-scale field experiments were carried out in and near Rostov-on-Don on the control of larvae and pupae of *Anopheles maculipennis*, Mg., by means of acidol, which is a mixture of naphthene acids obtained in the process of distillation of petroleum oils. The sample tested came from Batum, and no analysis was made of its chemical composition or physical properties. It proved to be highly toxic to the larvae and pupae, and gave complete mortality in 2–24 hours when it was poured on to the surface of the water at a rate equivalent to 32·4 lb. per acre and the temperature of the water was 25–31°C. [77–87·8°F.]. It formed a thin film that did not break up for three days. At water temperatures below 17°C. [62·6°F.] it did not spread, but formed thick drops, and the larvae survived.

[Zvyagintzev (S. N.).] **Звягинцев (С. Н.). Contribution au problème de la faculté séléctive des femelles anophèles lors de la ponte et le sort des oeufs pondus dans des collections d'eau de salinité diverse.** [*In Russian.*]—*Med. Parasit.* **8** no. 2 pp. 181–189, 2 graphs, 6 refs. Moscow, 1939. (With a Summary in French.)

The investigations described were carried out in Daghestan in 1936 with females of *Anopheles maculipennis*, Mg., races *maculipennis* (*typicus*) and *sacharovi*, Favr, under conditions as natural as possible. The mosquitos were collected daily in animal quarters and released in a box that contained rabbits and communicated directly with a large insectary placed in a garden. Earthenware vessels 16 ins. in diameter were sunk flush with the soil in the insectary and filled with about 2 gals. water containing from 0 to 3 per cent. salt. The positions of the vessels were changed daily, as it was found that the mosquitos were inclined to oviposit in those nearest to the opening of the box or to the walls and corners of the insectary. The results showed that females of race *sacharovi* deposited fewer egg batches as the salinity of the water increased from 0 to 1·75 per cent., but females of the typical race oviposited indiscriminately on water of up to 1·5 per cent. salt content. At 1·75 per cent. there was a sharp decrease in the numbers of eggs laid, but some females of both races oviposited on water containing 2, 2·5 and even 3 per cent. salt.

The percentage of non-viable eggs, which are distinguished by their whitish coloration, increased with the salt content of the water. This was not due to the parent females, since of eggs laid by individual females of each race, all those deposited on fresh water hatched, as compared with only 15–20 per cent. of those deposited on water containing 1·5 per cent. salt. Eggs on water containing 2 or 3 per cent. were deformed and only 14 and 9 per cent., respectively, hatched. Many normal eggs that were transferred to such solutions eventually contained fully developed larvae, but very few hatched, probably owing to the osmotic pressure of the solution on the chorion, and none reached the second instar.

[KALANDADZE (L. P.) & TAIROVA (A. I.).] **Каландадзе (Л. П.) и Таирова (А. И.). Découverte des larves d'*Anopheles hyrcanus* var. *mesopotamiae* au creux d'un vieux chêne et d'un *Aëdes* (*St.*) *aegypti* L. à la ville de Tbilisi.** [*In Russian.*]—*Med. Parasit.* **8** no. 2 p. 190. Moscow, 1939.

Larvae taken from a hollow in the trunk of an old oak tree in the mountains of eastern Georgia in the summer of 1936 gave rise to adults of *Anopheles hyrcanus* var. *mesopotamiae*, Chr. & K. C. The hollow occurred at a height of 30 ins. from the ground and contained reddish-brown water covering a thick layer of decomposed vegetable matter, chiefly leaves. Other larvae present were those of *A. plumbeus*, Steph., and *Aëdes geniculatus*, Ol.

In October 1938, larvae of *A. aegypti*, L., were observed in Tiflis, together with those of *Anopheles maculipennis*, Mg., and *Culex pipiens*, L., in a barrel containing tap water. *A. aegypti* has not previously been recorded in Georgia further east than Kutais.

LEPŞI (I.). **Sur quelques moustiques et sur la malaria en Bessarabie.** —*Bul. Muz. region. Basarab. Chişinău* no. 9 pp. 47–71, 8 refs. Chişinău, 1938.

An account is given of further investigations on Anophelines and malaria in Bessarabia [*cf. R.A.E.*, B **26** 102], carried out in 1936–38. Observations on other mosquitos are also included. Of the hibernating mosquitos collected in cellars in the town of Chişinău, *Culex pipiens*, L., was again the predominant species, its ratio to *Anopheles maculipennis*, Mg., averaging 240 : 1 for the two years. In all, only 26 examples of *A. maculipennis* were taken and more than one seldom occurred in a cellar. Figures are given showing the numbers of cases of malaria due to *Plasmodium vivax*, *P. falciparum* and *P. malariae* during the years 1932–38. *P. vivax* was predominant, but the numbers due to *P. falciparum* are unusually high for an area where the sole vector is *A. maculipennis*. As 5–8 per cent. of the population of the town still suffer from malaria, the author concludes that its incidence has not decreased, in spite of a certain amount of reclamation work that has been carried out in the swamps of the Bâc.

Observations in 13 villages in a district bordering on the marshes of the Bâc [*cf. loc. cit.*] showed that malaria became less common as the villages were situated further from the marshes, which afford numerous breeding places for *A. maculipennis*. Of the Anophelines taken in houses in a town in the delta of the Danube in July–September 1938, *A. hyrcanus*, Pall., was more numerous than *A. maculipennis*, but neither was abundant. The malaria index for 1924–38 averaged only 1·7 per cent., and almost all the cases were infected by *P. vivax*.

MAROTTA (G.) & SANDICCHI (G.). **Contributo all'infezione sperimentale di anofeli con *Plasmodium malariae* e inoculazione della malattia all'uomo.** [A Contribution to the experimental Infection of *Anopheles* with *P. malariae* and Transmission of the Disease to Man.]—*Riv. Malariol.* **18** (1) pt. 2 pp. 89–94, 1 chart, 9 refs. Rome, 1939. (With Summaries in English and German.)

Factors that render difficult the infection of Anophelines with *Plasmodium malariae* and its subsequent transmission to man are

the restricted occurrence of the gametocytes and the long duration of the development cycle in the Anopheline. The necessary conditions are a temperature suited to the parasite and a humidity that permits the Anopheline to survive until the sporozoites reach the salivary glands. Cases of successful experimental transmission are reviewed from the literature. In the authors' experiments in Italy in 1936, 15 laboratory-bred females of *Anopheles maculipennis* race *messeae*, Flni., were allowed to feed on a carrier of gametocytes of *P. malariae* and were then kept at 25°C. [77°F.] and 80 per cent. relative humidity, conditions under which sporozoites of *P. falciparum* or *P. vivax* reach the salivary glands of this Anopheline 12–14 days after an infecting feed. Six of the mosquitos died on the 23rd day after the infecting feed, and these and two that were killed on the same day were shown to contain 2–6 oöcysts in the stomach. On the 24th day, two dissected females contained sporozoites in the salivary glands, and two men on whom the Anophelines were allowed to feed on the 24th and 27th days subsequently developed malaria.

van Thiel (P. H.) (in collaboration with J. Reuter, J. Sautet & L. Bevere). **On Zoophilism and Anthropophilism of *Anopheles* Biotypes and Species.**—*Riv. Malariol.* **18** (1) pt. 2 pp. 95–124, 2 pls., 28 refs. Rome, 1939. (With Summaries in French and Italian.)

The investigations described in this paper were carried out to determine the factors responsible for the feeding preferences of Anophelines. In this connection, three hypotheses have been advanced. Roubaud considered that the choice of food was determined by the maxillary index of the Anopheline [*R.A.E.*, B **10** 53; **16** 210; **21** 140]; Hackett & Missiroli attributed it to the odour of the host animal [**19** 107]; while Martini & Teubner held that feeding was induced by favourable microclimatic conditions [**21** 137].

The results are given of investigations on the maxillary indices of Anophelines in the Netherlands Indies. Owing to the method adopted, they have to be reduced by 1·6 to render them comparable with those obtained by the French method. Additions to the author's list [**24** 90] are *Anopheles hyrcanus* var. *sinensis*, Wied., *A. bancrofti*, Giles, *A. punctulatus*, Dön., and *A. punctulatus moluccensis*, Sw. & Sw., of which the indices were 14·6, 14·5, 14·5 and 14·7, respectively. The last three species are highly anthropophilous and dangerous in the eastern part of the archipelago, but their maxillary indices were higher than those of the other species, the number of teeth being sometimes 19–20. Roubaud's hypothesis seems in general to hold true for the Anophelines of the Netherlands Indies when formulated as follows: When the "reduced index" is less than 12, there is a great risk that the species may be insufficiently zoophilous and therefore liable to transmit malaria; when the index is 13–14 the species may be presumed to be zoophilous; and when the index exceeds 14, the species may be again dangerous.

The author does not, however, agree with the theoretical basis of the hypothesis and cannot believe that the behaviour of Anophelines towards man and animals is determined by their maxillary armature, in view of the results obtained for several species in the Netherlands Indies [**24** 90]. He recapitulates experiments in Holland on the feeding preferences of *Anopheles maculipennis* race *atroparvus*, van

Thiel, made with a small "choice apparatus" and in other ways [**24** 224; **25** 170, 171], and with this race in Holland and races *labranchiae*, Flni., and *sacharovi*, Favr (*elutus*, Edw.) in Italy, using a larger one that provided more natural conditions and was fitted with a new type of trap for catching the mosquitos that sought to enter the boxes containing the man and the pig [**27** 162]. The horizontal slit through which the mosquitos enter the trap has vertical gauze screens on the inside so that the mosquitos have to fly upwards. As they do not fly directly downwards, they are prevented from escaping by the slit. The experiments with this apparatus in Holland showed that the attractiveness of the pig was not offset by an increase in temperature or a decrease in saturation deficiency in the box containing the man. It is concluded therefore that food preference is determined not by microclimate, but by the odour of the animal host.

DEL VECCHIO (G.). **Osservazioni sulle ninfe di** *A. claviger* (*bifurcatus*). **Nota I.** *A. claviger* **var.** *missiroli*. [Observations on the Pupae of *A. claviger*. Note I. *A. claviger* var. *missiroli*.]—*Riv. Parassit.* **3** no. 2 pp. 117–137, 4 pls., 3 refs. Rome, 1939. (With Summaries in English, French and German.)

The author discusses the identification of Anopheline pupae and gives details of the morphology of the pupa of *Anopheles claviger*, Mg., var. *missiroli*, Del Vecchio [*R.A.E.*, B **27** 175], based on material taken in the province of Littoria, Italy, together with characters distinguishing it from that of var. *petragnani*, Del Vecchio. The pupae of both varieties differed from that described by Senevet as *A. claviger* (*bifurcatus*, auct.) [**20** 69], which may represent a still further variety.

CORRADETTI (A.). **Notizie preliminari sulla fauna anofelica della regione di Gondar; del Lago Tana e della regione del Semien.** [Preliminary Notes on the Anopheline Fauna of the Region of Gondar and of Lake Tsana and of the Semien Region.]—*Riv. Parassit.* **3** no. 2 pp. 153–156, 2 maps. Rome, 1939. (With Summaries in English, French and German.)

Anophelines bred from larvae taken in the region of Gondar and of Lake Tsana, Abyssinia, in 1938 [*cf. R.A.E.*, B **27** 137] comprised *Anopheles cinereus*, Theo., *A. pretoriensis*, Theo., *A. demeilloni*, Evans, *A. coustani*, Lav. (*mauritianus*, Grp.), *A. christyi*, Newst. & Cart., and *A. garnhami*, Edw., while those bred from larvae taken in the Semien region in 1937 were *A. rhodesiensis* var. *dthalisimilis*, Corradetti [**27** 176], *A. pretoriensis*, and *A. rufipes*, Gough, which has not previously been recorded from Italian East Africa. A single adult of *A. gambiae*, Giles, was taken in this region in 1938.

SALERNO (A.). **Osservazioni biologiche sull'***Hypoderma bovis* **nel Agro Romano.** [Biological Observations on *H. bovis* in the Roman Campagna.]—*Riv. Parassit.* **3** no. 2 pp. 171–186, 6 refs. Rome, 1939. (With Summaries in English, French and German.)

An account is given of observations made near Rome in 1933–37 on infestation by *Hypoderma bovis*, DeG., among about 400 head of cattle that were nearly all on the pastures by day and night from April to October.

Tables are given showing that 1935 and 1936 were the years of minimum and maximum rainfall, respectively, and that infestation was least severe in 1936 and most so in 1937. Climatic factors other than rainfall were not investigated, because the relation between them and the development of warble flies is insufficiently known. Infestation was more frequent and the larvae were more numerous in young animals (1–2 years old) than older ones. No warbles were observed on either young or old buffalos, though they were kept in the open all the year round. Cattle of a local race were the most resistant to attack, while animals of the Dutch spotted races were the most susceptible, probably owing to their finer skin, which allows the larvae to enter the body more easily. The results of observations on the dates of appearance of the warbles and of the emergence of the larvae in the four years and in different races of cattle are tabulated and discussed.

Duren (A.). **Clef des anophèles du Congo belge.**—*Ann. Soc. belge Méd. trop.* **19** no. 2 pp. 161–191, 12 figs., 1 ref. Brussels, 1939.

This key to the adult females of the species of *Anopheles* that occur in the Belgian Congo is compiled from information contained in "Mosquitoes of the Ethiopian Region" by A. M. Evans [*R.A.E.*, B **26** 182]. It is preceded by definitions of the terms used and followed by additional notes on the morphology of the 32 species concerned.

Radna (R.). **Contribution au problème de la transmission de la lèpre. Les formes de la lèpre dans la région de Pawa et leur infectiosité. Deuxième note : La transmission du bacille de Hansen.**—*Ann. Soc. belge Méd. trop.* **19** no. 2 pp. 201–225, 1 chart, 13 refs. Brussels, 1939.

In the course of this paper on the transmission of leprosy, the author gives the results of examination in the Belgian Congo of a number of Arthropods taken on lepers or in their dwellings or kept experimentally in contact with material from leprous nodules for different periods of time. Bacilli resembling those of leprosy were found in bed-bugs [*Cimex*] from dwellings, and in or on those left in contact with infected material, in mosquitos from dwellings, and in those kept in contact with infected material or fed on persons with cutaneous leprosy, in Tabanids (*Tabanus* and *Chrysops*) fed on cases of cutaneous leprosy, and in a Psychodid caught in the room where dressings were done. They were also found in fleas, including *Tunga* (*Sarcopsylla*) *penetrans*, L., in *Demodex folliculorum*, Simon, and *Sarcoptes scabiei*, L., and in one instance in small numbers in *Pediculus humanus capitis*, DeG., all from cases of cutaneous leprosy, in cockroaches from the dwellings of cutaneous cases, and in the excreta of those kept in contact with infected material.

It is concluded that bed-bugs may transmit the bacilli directly if they bite a healthy person immediately after an infecting feed, but that they are probably incapable of transporting them to a distance, since they did not harbour them for more than a few days. Flies are not considered to be of any great importance, even though they were found infected ; the bacilli generally occurred in small numbers only and when ingested by Tabanids disappeared from the organism in about 24 hours. Although from the life-cycle of *Tunga penetrans*

and from the fact that no bacilli were found on the eggs, it appears unlikely to be concerned directly in transmission, the leprosy bacillus may gain entrance through the numerous lesions that it causes. This may also be the case with lesions caused by mites, which are frequently found in the skin of natives and may possibly be vectors. Transmission by lice appears to be most unlikely. Cockroaches probably harbour the bacilli for long periods and may aid in their spread.

Joyeux (C.), Sicé (A.) & Sautet (J.). **Note préliminaire sur l'anophélisme au Soudan français.**—*Bull. Soc. Path. exot.* **32** no. 6 pp. 616–617, 3 refs. Paris, 1939.

An Anopheline survey carried out in the French Sudan at the height of the rainy season (July to October) in 1937 and 1938 [*cf.* *R.A.E.*, B **27** 263] showed that *Anopheles gambiae*, Giles, and *A. funestus*, Giles, were ubiquitous, the former being much the more abundant, whereas *A. coustani*, Lav., *A. pharoensis*, Theo., *A. rufipes*, Gough, and a species tentatively identified as *A. squamosus*, Theo., were taken almost exclusively in the irrigated region of the upper Niger, where the land reclamation has led to a modification of the water conditions and malaria is particularly severe. *A. gambiae*, *A. pharoensis* and *A. coustani* occurred there in large numbers, *A. funestus* was widely distributed, and the other species were rare.

Joyeux (C.) & Sautet (J.). **Contribution à la biologie de *Linognathus setosus* (Olfer, 1916) pou du chien. Son aptitude à piquer l'homme.** —*Bull. Soc. Path. exot.* **32** no. 6 pp. 618–621. Paris, 1939.

Examination of the digestive tracts of 176 examples of *Linognathus setosus*, Olf. (*piliferus*, Burm.) taken from dogs showing no forms of *Leishmania* in the skin revealed no parasites, and it is therefore concluded that the parasites previously observed in examples of this louse from dogs infected with Mediterranean visceral leishmaniasis [*R.A.E.*, B **26** 254] were obtained from the dogs. Experiments described show that both the nymphs and adults of *L. setosus* will occasionally bite man. The bite is imperceptible. The louse engorges slowly and emits a drop of faecal fluid, an observation that is interesting in view of the part that they may play in the transmission of *Leishmania*. The fact that they disappear from dogs when a furfuraceous dermatitis develops [*cf. loc. cit.*] was confirmed.

Raynal (J.) & Fournier (J.). **Le typhus exanthématique de Chang-Haï.**—*Bull. Soc. Path. exot.* **32** no. 6 pp. 636–643, 14 refs. Paris, 1939.

An account is given of an outbreak of typhus that occurred in Shanghai from March to July (inclusive) in 1938. In spite of the overcrowding brought about by the influx of refugees, the prevalent conditions of under-nourishment and exposure to cold, and the abundance of lice [*Pediculus humanus*, L.], it involved only a little over 1,000 cases (with a mortality of 18 per cent.) out of a population of 3–4 millions. Sporadic cases of typhus had occurred in Shanghai previously, but there had been no epidemic for 80 years, although epidemics of louse-borne relapsing fever are recorded annually. A

strain of typhus was isolated from local rats (*Mus rattus*), and other strains not identical with the typical virus of epidemic louse-borne typhus were isolated from man. From these facts, the authors conclude that enzootic murine typhus may occasionally infect man and under exceptionally favourable conditions may be transmitted from man to man by lice and thus become epidemic [*cf. R.A.E.*, B **20** 245; **21** 141].

KIRK (R.). **The Epidemiology of Relapsing Fever in the Anglo-Egyptian Sudan.**—*Ann. trop. Med. Parasit.* **33** no. 2 pp. 125–140, 1 map, 1 fig., 43 refs. Liverpool, 1939.

The following is taken largely from the author's summary: The history of relapsing fever in the Sudan is summarised, and certain relevant physiographical, racial and economic features of the country are noted. Louse-borne relapsing fever was introduced into the Sudan during the period 1908–24 from Egypt, in 1926 from French West Africa, and in 1936 from Italian East Africa [*cf. R.A.E.*, B **27** 129]. There is no evidence that louse-borne relapsing fever exists in endemic form in the Sudan. Each time the disease has appeared, its origin has been traceable to infected immigrants from adjoining countries. During the last 12 years the incidence of the disease has been confined almost entirely to adult male "westerners," that is, natives from the western part of northern Sudan and French West Africa, either migrating eastwards from these areas or returning from Abyssinia. The disease shows a tendency to seasonal incidence at the end of the rains, and this is correlated with the seasonal movements of these immigrant labourers rather than with meteorological variations. Although a close association has been observed elsewhere between epidemics of louse-borne relapsing fever and louse-borne typhus, no such relation exists in the Sudan, where the latter is apparently unknown. The author demonstrated [*loc. cit.*] that the strain that produced the outbreak in 1936–37 was transmitted by the louse [*Pediculus humanus*, L.] but was unable to infect *Ornithodorus savignyi*, Aud., or *Argas persicus*, Oken. The spread of louse-borne relapsing fever to the southern part of the Sudan is likely to be prevented by the fact that the naked southern races are not infested by lice. However, *Ornithodorus moubata*, Murr., is present in this area and tick-borne relapsing fever may, therefore, occur. The only species of *Ornithodorus* present in the northern part of the Sudan is *O. savignyi*, and although under experimental conditions this tick can transmit all the varieties of relapsing fever transmissible by *O. moubata*, the infection is not hereditary, and this may account for the fact that it has never been found infected in nature. It seems unlikely, therefore, that tick-borne relapsing fever will become established in this area.

RODHAIN (J.). **Mode de transmission de *Trypanosoma vespertilionis* Battaglia par les arthropodes.**—*C. R. Soc. Biol.* **131** no. 19 pp. 814–818, 4 refs. Paris, 1939.

Having found *Trypanosoma vespertilionis* in bats for the second time in Belgium, the author undertook experiments, some of which are described, to determine its behaviour in various Arthropods fed on cultures of it. He concludes that in the digestive tract of *Cimex lectularius*, L., *Ornithodorus moubata*, Murr., and *Panstrongylus* (*Triatoma*) *megistus*, Burm., the cultural forms find a medium favourable for

multiplication and would probably persist indefinitely, provided that the blood meals taken were sufficiently frequent. In the nymphs of *O. moubata* and *P. megistus*, the percentage of infection decreases as the period of starvation is prolonged. Metacyclic forms are produced in *O. moubata* and *C. lectularius*. They are found in the haemocoelic fluid in the former and in the mid- and hind-guts of the latter. When the liquid absorbed by *Cimex* is completely digested, the trypanosome survives longest in the hind-gut, but it is not possible to conclude from the experiments that it will persist indefinitely in the adult bugs when starvation is prolonged. It is considered extremely improbable that transmission is effected by biting ; it probably takes place through the faeces or through the ingestion of the Arthropod vectors.

BARTLETT (K. A.). **The Introduction into Puerto Rico of Beneficial Insects to Aid in the Control of the Horn Fly of Cattle.**—*Agric. Notes P. R.* [fed.] *Exp. Sta.* no. 88, 6 pp. Mayaguez, P. R., 1939.

During the years 1936–38, four species of dung beetles and a Pteromalid pupal parasite, *Spalangia philippinensis*, Fullaway, were introduced into Porto Rico to aid in the control of *Lyperosia* (*Haematobia*) *irritans*, L. [*cf. R.A.E.*, B **27** 190], which is a serious pest of cattle on the south coast [*cf.* **25** 159]. Details of the liberations, showing species, numbers, dates and localities, are given in a table ; the total numbers were 11,064 of *Canthon pilularius*, L., and 8 of *Phaneus triangularis*, Say, which were introduced from Texas, and 330 of *Copris incertus* var. *prociduus*, Say (comprising 54 adults and 276 dung balls containing larvae), 341 of *Onthophagus incensus*, Say [*cf.* **23** 173] and 10,077 of *Spalangia philippinensis* [*cf.* **5** 137], all of which were introduced from Hawaii. Notes are given on the rearing of *S. philippinensis* [*cf.* **27** 190] and of *C. incertus* var. *prociduus*. To hold the ball of dung containing the egg, the female of the latter constructs an earthen chamber in the soil at a depth of 6 inches. The larva feeds within the ball until it is mature. The life-cycle from egg to adult lasts approximately 2 months.

Two adults of *Spalangia* were reared in July 1937 from puparia of *Anastrepha acidusa*, Wlk., found in a locality in which a batch of *S. philippinensis* had been liberated in the preceding March. In addition to the native parasites of Muscid flies already mentioned [**27** 190], *Muscidifurax raptor*, Gir. & Sand., was reared in small numbers, while *Spalangia haematobiae*, Ashm., was recorded as parasitising *L. irritans* in 1935–36.

BRUCE (W. G.). **Some Observations on Insect Edaphology.**—*J. Kans. ent. Soc.* **12** no. 3 pp. 91–93, 1 fig., 5 refs. Manhattan, Kans., 1939.

The author describes experiments in which pupae of *Lyperosia* (*Haematobia*) *irritans*, L., *Musca domestica*, L., and *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.) were kept at a temperature of approximately 80°F. in jars of fine sand, in which the water content was maintained at given percentages between 0 and 17. A high proportion of adults of *C. hominivorax* emerged from sand containing less than 14 per cent. water and none when the content was more than 16·1 per cent. [*cf. R.A.E.*, B **27** 54]. These results confirm the frequent observation made during the outbreak of this fly in Florida in 1935–36 that the moisture content of the soil had a direct

effect on its relative abundance. During periods of heavy rainfall, the infestations were most abundant in livestock on high, well-drained soils and relatively scarce on low, wet soils. The converse was true in the dry season. This may indicate that, in nature, a dry soil is a factor contributing to the control of the fly, even though the highest emergence in the laboratory was from pupae in dry sand. Similar results were obtained with *M. domestica*. In sand containing less than 0·25 or more than 14·5 per cent. moisture, the development of the pupae of *L. irritans* was inhibited ; the highest emergence was obtained from sand with approximately 7 per cent. moisture. In nature, this fly is relatively scarce during periods of prolonged drought and increases in numbers rapidly after sufficient rainfall. The larvae, upon reaching maturity, pupate in dung or soil, whichever offers the more favourable conditions of moisture. Ordinarily they prefer to pupate in soil containing from 3·5 to 5 per cent. moisture (by weight), and experience in rearing thousands under various conditions has clearly demonstrated the susceptibility of the pupae to unfavourable conditions of moisture.

Papers noticed by Title only.

de Beaurepaire Aragão (H.). **Observaciones sobre los Ixodideos de la República Argentina.** [Notes on the Ticks of Argentina.]—*9. Reun. Soc. argent. Pat. reg., Mendoza 1935* **3** pp. 1476–1488, 7 figs., 36 refs. Buenos Aires, 1939. [See *R.A.E.*, B **24** 89.]

Orfila (R. N.). **Simulidae (Diptera) de la República Argentina.**—*9. Reun. Soc. argent. Pat. reg., Mendoza 1935* **3** pp. 1525–1534. Buenos Aires, 1939.

Sergent (Et.). **Un caractère anatomique de la nymphe d'***Anopheles maculipennis* **apparaissant parfois chez la larve.**—*Arch. Inst. Pasteur Algérie* **17** no. 2 pp. 244–246, 3 figs. Algiers, 1939.

Senevet (G.) & Abonnenc (E.). **Les moustiques de la Guyane française.—III. Les Sabéthinés** [including 5 new species and keys based on the larvae and male hypopygia].—*Arch. Inst. Pasteur Algérie* **17** no. 2 pp. 247–281, 16 figs. Algiers, 1939. [*Cf. R.A.E.*, B **27** 248.]

Blacklock (D. B.). **Notes on Siphon Action, with special Reference to Anti-mosquito Work.**—*Ann. trop. Med. Parasit.* **33** no. 2 pp. 141–160, 8 figs., 6 refs. Liverpool, 1939.

Russell (Sir A. J. H.). **A Note on the Yellow Fever Position.**—*J. Malar. Inst. India* **2** no. 2 pp. 115–120. Calcutta, 1939. [See *R.A.E.*, B **27** 191.]

Lewis (D. J.) & Kirk (R.). **The Occurrence of** *Phlebotomus clydei* **in Africa** [Anglo-Egyptian Sudan] **(Dipt.).**—*Proc. R. ent. Soc.* (B) **8** pt. 8 pp. 155–156, 3 figs., 5 refs. London, 1939.

Sullivan (W. N.), Goodhue (L. D.) & Haller (H. L.). **Rotenone Series Compounds. A Study of Toxicity to the Housefly** [*Musca domestica*, L.] **of Optically Active and Inactive Compounds of the Rotenone Series.**—*Soap.* **15** no. 7 pp. 107, 109, 111, 113, 2 figs., 18 refs. New York, N.Y., 1939. [See *R.A.E.*, A **28** 19.]

[TIFLOV (V. E.) & USOV (Ya. A.).] **Тифлов (В. Е.) и Усов (Я. А.). Contributions relatives à certains rongeurs de l'ouest de Kazakhstan et leurs ectoparasites.** [*In Russian.*]—*Rev. Microbiol.* **17** (1938) no. 1–2 pp. 140–152, 4 figs., 2 refs. Saratov, 1939. (With a Summary in French.)

Notes are given on fleas found on seven species of rodents in Western Kazakstan. One of the rodents (*Spalax uralensis*) and one of the fleas found on it (*Ctenophthalmus uralospalacis*) are described as new, the latter from adults of both sexes. Only one out of 941 fleas taken on dogs and two out of 2,100 on cats were species that normally occur on wild rodents. A list is appended of the 47 species of fleas recorded from Western Kazakstan.

SERGENT (Ed.), PARROT (L.), DONATIEN (A.) & LESTOQUARD (F.). **La prophylaxie de la leishmaniose générale méditerranéenne.**—*Arch. Inst. Pasteur Algérie* **17** no. 2 pp. 221–230, 7 refs. Algiers, 1939.

Human visceral leishmaniasis caused by *Leishmania infantum*, which is sporadically distributed throughout the Mediterranean basin, is showing a tendency to spread in certain regions. The authors therefore recommend various control measures based on the assumption that the disease is transmitted by sandflies of the group of *Phlebotomus major*, Ann., particularly *P. perniciosus*, Newst., from dogs infected with visceral leishmaniasis, which they prefer to call canine general leishmaniasis, since the parasites are not confined to the viscera, but are also present in the skin, even when there are no dermal lesions. The measures include the removal from the vicinity of houses of vegetable débris on which the sandfly larvae feed, the catching every morning of adults in dwellings, animal sheds, etc., the use of fine-meshed mosquito nets, especially in the case of children, the avoidance of houses surrounded by vegetation or brushwood where the soil is covered with a thick carpet of vegetable matter that forms suitable cover for the larvae, the selection of well-ventilated and well-lit houses that are less likely to afford shelter for the adults, the destruction of infected and stray dogs, and the prevention of the movement of any dogs to or from areas where the disease is endemic.

PARROT (L.) & BIOJOUT (R.). **Notes sur les phlébotomes. XXIX.—Sur la presence de *Phlebotomus alexandri* Sinton dans le Sahara septentrional.**—*Arch. Inst. Pasteur Algérie* **17** no. 2 pp. 233–234, 1 fig. Algiers, 1939.

The three species of *Phlebotomus* taken at Ouled Jellal (altitude about 600 ft.) were *P. papatasii*, Scop., *P. parroti*, Adl. & Thdr., and *P. alexandri*, Sinton, which has previously been found in Algeria only in the mountainous region of the Aurès (altitude about 2,300 ft.) [*cf. R.A.E.*, B **25** 166].

RISTORCELLI (A.). **Phlébotomes de Zeugitane et revision des phlébotomes de Tunisie.**—*Arch. Inst. Pasteur Algérie* **17** no. 2 pp. 235–241, 7 refs. Algiers, 1939.

Notes are given on the seasonal prevalence in 1938 of *Phlebotomus papatasii*, Scop., *P. perniciosus*, Newst., and *P. parroti*, Adl. & Thdr.,

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at Zaghouan at an altitude of 800 ft. on the slopes of the Zeugitane mountains, and the distribution of the species of *Phlebotomus* recorded from Tunisia is reviewed from the literature.

HÖRING (F. O.). **Gelbfieberbekämpfung in Brasilien.** [Yellow Fever Control in Brazil.]—*Arch. Schiffs- u. Tropenhyg.* **43** pt. 8 pp. 352–368, 1 fig., 38 refs. Leipzig, 1939.

An account is given of the national organisation of yellow fever control in Brazil, including work against *Aëdes aegypti*, L. Houses and gardens are inspected weekly, and breeding places are destroyed. If this is not possible, small collections of water are oiled and large ones are stocked with fish that destroy mosquito larvae. About every 3 months, systematic catches are made of adult mosquitos to ascertain whether *A. aegypti* is present. The results have exceeded expectations. Whereas it was formerly considered that an epidemic would not begin if the percentage of houses infested by *A. aegypti* was maintained below 15 and would be terminated if it was brought below 5, complete freedom from infestation is now being aimed at. This also leads to economy in measures and personnel, since when it is reached, work can be temporarily suspended [*cf. R.A.E.*, B **26** 42]. The discovery of the existence of jungle yellow fever [*cf.* **24** 34] has shown the impossibility of completely eliminating the disease and the need for an organisation, working uninterruptedly, to prevent its spread.

REGENDANZ (P.) & MUNIZ (J.). **La trasmisión del tifus exantemático de San Pablo por la garrapata** *Rhipicephalus sanguineus.* [The Transmission of São Paulo Exanthematic Typhus by the Tick, *R. sanguineus.*]—*9. Reun. Soc. argent. Pat. reg., Mendoza 1935,* **3** pp. 1539–1562. Buenos Aires, 1939.

Experiments were carried out in Rio de Janeiro in 1934–36 on the transmission by *Rhipicephalus sanguineus*, Latr., of the virus of Brazilian (São Paulo) exanthematic typhus, which is closely allied to Rocky Mountain spotted fever [*R.A.E.*, B **23** 138, 139 ; **27** 35] and has been stated to be transmitted by ticks [**21** 67 ; **23** 139]. They showed that the disease was transmitted to healthy guineapigs by the bite or injection of a suspension of nymphs from larvae that had engorged on an infected animal, in one case of injection 107 days after the infecting feed. It was also transmitted by injection of suspensions of adult ticks from infected larvae, some of which had partly and others completely engorged on dogs, but not of suspensions of the ovaries and the eggs of one example of which the gut was found by inoculation to be infective. The author does not, however, exclude the possibility that in certain cases the virus may be transmitted through the egg.

JÖRG (M. G.). **Dermatosis lepidopterianas.** (**Segunda nota.**) [Dermatitis caused by Lepidoptera. (Second Note.)]—*9. Reun. Soc. argent. Pat. reg., Mendoza 1935* **3** pp. 1617–1639, 14 figs., 17 refs. Buenos Aires, 1939.

In this second paper [*cf. R.A.E.*, B **24** 194], the author reviews the literature on dermatitis caused by contact with various Lepidoptera, describes the course of the affection from observations made in

Argentina, and states that the only species that cause dermatitis there in the egg, larval and adult stages are the Saturniids, *Hylesia nigricans*, Berg, and *H. fulviventris*, Berg. Lesions due to contact with the adults are the most troublesome. The larvae of eight other Lepidoptera produce local irritation, and those of three more give rise to neuralgia.

Jörg (M. E.). **Inervación de glándulas cutáneas en orugas de** *Hylesia nigricans* **(Lepidopt. Hemileucidae).** [The Innervation of the cutaneous Glands in Larvae of *H. nigricans*.]—*9. Reun. Soc. argent. Pat. reg., Mendoza 1935* **3** pp. 1663–1668, 4 figs. Buenos Aires, 1939.

The author describes the results of an examination of sections of the integument of the larva of the Saturniid, *Hylesia nigricans*, Berg, which causes dermatitis by contact, and discusses the reactions that take place in the larva when it is touched.

da Fonseca (F.). **Notas de Acareologia. XXVII.** *Liponissus brasiliensis*, **sp. n., parasita habitual de roedores e accidental do homen.** —*Mem. Inst. Butantan* **12** pp. 147–154, 3 figs., 5 refs. S. Paulo, 1939. (Also in English, pp. 155–160.) **XXVII. Ocorrencia de** *Dermanyssus gallinae* **(Degeer, 1778) no Brazil (Acari, Dermanyssidae).**—*T.c.* p. 161, 2 refs. (Also in English, p. 163.)

In the first paper, descriptions are given of the larva, protonymph and adults of *Liponyssus brasiliensis*, sp. n., taken on various rodents and other small mammals in São Paulo, and occasionally on man. This mite has previously been recorded as *L. bacoti*, Hirst [*R.A.E.*, B **21** 68; **22** 73; **24** 2].

It is stated in the second paper that *Dermanyssus gallinae*, DeG., has been found in São Paulo on cage birds bred in Brazil. It is common on fowls in Europe and North America, but previous records from fowls in Brazil actually refer to *Liponyssus bursa*, Berl.

da Fonseca (F.). **Observação de uma fase do ciclo evolutivo de** *Cuterebra apicalis* **Guérin (Diptera. Oestridae).** [A Phase of the evolutional Cycle of *C. apicalis*.]—*Mem. Inst. Butantan* **12** pp. 195–196, 1 pl., 1 ref. S. Paulo, 1939. (With a Summary in English.)

The pupal stages of two examples of *Cuterebra apicalis*, Guérin, taken as larvae parasitising a wild rat (*Oryzomys eliurus*) in Brazil, lasted 113 and 125 days.

Wilson (F. H.). **The Life-cycle and Bionomics of** *Lipeurus caponis* **(Linn.).**—*Ann. ent. Soc. Amer.* **32** no. 2 pp. 318–320, 2 refs. Columbus, Ohio, 1939.

In continuation of work on the lice of poultry [*cf. R.A.E.*, B **22** 251], observations were made in 1937 on the bionomics of *Lipeurus caponis*, L., which was collected on fowls in Louisiana and reared on feathers in an incubator in which the temperature was usually 32–33°C. [89·6–91·4°F.]. The egg stage lasted 4–7 days and the three nymphal instars 6–18, 5–16 and 6–9 days, respectively. It is shown that the three nymphal instars can be recognised by head measurements and by the hairs in the postero-lateral angles of the metathorax. The high

mortality that occurred in the immature stages indicates that the conditions of temperature and humidity may not have been ideal, that some food other than feathers is occasionally required, or that disease organisms were present. Pairing was not observed. The fact that a female laid fertile eggs as long as 30 days after the death of the male suggests that fertilisation is not necessarily frequent and that possibly one pairing is sufficient for life. A number of eggs were laid by an unfertilised female that lived 36 days, but none of them hatched.

KNIPLING (E. F.). **A Key for Blowfly Larvae concerned in Wound and Cutaneous Myiasis.**—*Ann. ent. Soc. Amer.* **32** no. 2 pp. 376–383, 2 pls., 11 refs. Columbus, Ohio, 1939.

Keys are given to aid workers in identifying in the second and third instars larvae implicated in infestations in wounds and in cases of cutaneous myiasis in animals in the United States, together with one for determining to which instar a larva belongs. Second-instar larvae of *Lucilia* and second- and third-instar larvae of *Calliphora*, *Cynomyia* and *Sarcophaga* are not specifically identified in the keys.

JANJUA (N. A.). **A Note on the Biology of *Lucilia sericata* Meigen (Calliphoridae, Diptera) in Baluchistan.**—*Curr. Sci.* **8** no. 7 pp. 317–319, 4 figs., 8 refs. Bangalore, 1939.

In Baluchistan, where sheep farming is one of the principal occupations of the people, losses due to *Lucilia sericata*, Mg. [*cf. R.A.E.*, B **27** 135] are causing considerable concern, and investigations begun by the author in 1937 have shown that 20–25 per cent. of the sheep in three districts are attacked. The injury is described and notes are given on the morphology and bionomics of the different stages of the fly. The females are attracted to the sheep after showers of rain by the odour arising from the fleece, and deposit eggs in clusters of 15–27. One female may lay as many as 200 at one time and about 1,000 altogether. The egg stage lasted 10–40 hours, the larval stage 5–11 days, the prepupal stage 3–16 days in summer and 137–162 days in winter, and the pupal stage 15–21 days in summer and 28–33 days in spring. Adults lived for 25–55 days. The prepupae are usually found ¼ inch below the surface of the soil, but they hibernate at a depth of 6–12 inches and return to the surface during March before pupating. Pairing takes place 5–6 days after emergence. There are four generations a year.

GIBSON (A.) & TWINN (C. R.). **Household Insects and their Control (with a Chapter on Animal Pests other than Insects).**—*Publ. Dep. Agric. Canada* no. 642 (Ent. Bull. no. 30) 100 pp., 102 figs., many refs. Ottawa, 1939. Price 25 *cts.*

This publication on household pests in Canada, which is a revision of one already noticed [*R.A.E.*, B **18** 21], includes, in addition to information on pests of foodstuffs, clothing, furniture, etc. [*cf.* A **28** 81], sections dealing with flies and mosquitos, with Arthropod parasites that may infest man, animals and birds in houses, with the fumigants and other insecticides recommended for the control of household pests, and with control by means of superheating or freezing.

SMIT (B.). **The Control of Household Insects in South Africa.**—*Bull. Dep. Agric. S. Afr.* no. 192, 52 pp., 20 figs., 14 refs. Pretoria, 1938. Price 6*d*. [Recd. 1939.]

Notes are given on the bionomics and control of various insects that may be pests in houses in South Africa, including *Musca domestica*, L., *Cordylobia anthropophaga*, Grünb., *Cimex lectularius*, L., lice (*Pediculus humanus*, L., and *Phthirus pubis*, L.), fleas, cockroaches and mosquitos.

McGOVRAN (E. R.), SULLIVAN (W. N.) & PHILLIPS (G. L.). **Resistance to Insecticides. The Effect of Knockdown and Light Doses on the Resistance of Houseflies to Pyrethrum Sprays.**—*Soap* **15** no. 8 pp. 88–90, 4 refs. New York, N.Y., 1939.

The authors describe experiments indicating that house-flies (*Musca domestica*, L.) that have been knocked down (paralysed) with ether or acetone or with pyrethrum-kerosene sprays low in pyrethrin content (0·5 mg. per cc.) are more resistant to kerosene sprays high in pyrethrin content (2·0 or 4·0 mg. per cc.) than are normal active flies.

SCHWARTZ (L.) & WARREN (L. H.). **Dermatitis caused by a new Insecticide.**—*Publ. Hlth Rep.* **54** no. 31 pp. 1426–1435, 3 refs. Washington, D.C., 1939.

An account is given of outbreaks of dermatitis occurring among workers manufacturing alpha naphthyl isothiocyanate and in two firms of spray manufacturers that had included this substance in their formulae [*cf. R.A.E.*, B **27** 57]. It is pointed out that many insecticides are skin irritants but it is general experience that they can be safely manufactured under proper working conditions. Rigorous tests should, however, be carried out under spraying conditions before this product is placed on the market for use in insecticides.

ZUMPT (F.). **Was wissen wir über die hygienische Bedeutung der Stomoxydinae?** [What is our Knowledge of the hygienic Importance of the Stomoxydinae?]—*Z. Hyg. InfektKrank.* **121** pt. 6 pp. 679–731, 5 figs., 5 pp. refs. Berlin, 1939.

This is a full review of the literature on the possible relation to the transmission of diseases of man and animals of *Stomoxys calcitrans*, L., and, in a few cases, species of *Lyperosia* (*Haematobia*). The mouthparts and method of sucking of *Stomoxys* are described.

SCHAERFFENBERG (B.). **Beobachtungen über die Widerstandsfähigkeit der Tabanidenlarven.** [Observations on the Powers of Resistance of Tabanid Larvae.]—*Anz. Schädlingsk.* **15** pt. 8 pp. 94–95, 4 refs. Berlin, 1939.

The author records that larvae of *Haematopota*, collected near Bonn, not only survived immersion for about 24 hours in a 3½ per cent. solution of formalin, but pupated and produced adults. Bibionid and Muscid larvae died. Muscid larvae are known to resist unfavourable conditions, so that Tabanids must possess a very high degree of resistance. Investigations on the resistance of Dipterous larvae to the action of poisons should therefore be made if they are to be controlled by insecticides.

Corradetti (A.). **Sulla fauna anofelica della regione Amarica.** [On the Anopheline Fauna of the Amhara Region.]—*Boll. Soc. ital. Biol. sper.* **14** no. 6–7 p. 352. Milan, 1939.

This list of the species of *Anopheles* recorded by the author in 1937–38 from the Amhara region, Abyssinia, includes, in addition to those already noticed [*R.A.E.*, B **26** 183; **27** 117, 175; **28** 11], *A. squamosus*, Theo., and *A. macmahoni*, Evans.

Roetti (C.). **Gli ixodidi dello Scioa e del Gimma.** [The Ixodids of Shoa and of Jimma.]—*Riv. Biol. colon.* **2** fasc. 3 pp. 185–192, 2 figs., 19 refs. Rome, 1939. (With Summaries in English, French and German.)

The author briefly reviews the diseases of man and domestic animals that are transmitted by ticks, and gives records of 12 species of Ixodids taken on domestic animals in Abyssinia, of which all occur in Shoa and 7 also in Jimma.

Caccavella (A.). **Nota preliminare sulle tripanosomiasi dell' occidente etiopico.** [A preliminary Note on the Trypanosome Diseases in western Abyssinia.]—*Riv. Biol. colon.* **2** fasc. 3 pp. 223–225. Rome, 1939. (With Summaries in French, English and German.)

In the Lechemti region, western Abyssinia, the author found *Trypanosoma congolense* in horses and mules, and *T. brucei*, *T. vivax* and *T. theileri* in cattle. *Glossina morsitans*, Westw., was observed in the plain of the neighbouring Didessa river.

Jack (R. W.). **Studies in the Physiology and Behaviour of** *Glossina morsitans* **Westw.**—*Mem. Dep. Agric. S. Rhod.* no. 1, 4+203+vii pp., 3 pls., 27 figs., 37 refs. Salisbury, 1939.

This paper, which is divided into two parts dealing respectively with the physiology and behaviour of *Glossina morsitans*, Westw., is based on the results of laboratory research carried out at Salisbury, Southern Rhodesia, since 1936 and on certain data, referring chiefly to behaviour, collected in the field over a number of years. A short section of the first part deals with high and low fatal temperatures and factors that may influence their variation, and with the effect of insolation. The rest of the part is chiefly concerned with the influence of atmospheric conditions on the pupae and adults, but includes such questions as the water and fat contents of the flies on emergence, the processes following feeding, the influence of pregnancy on water and fat contents, and the stimulus to feeding.

The subjects dealt with in the second part include the reactions of the flies to light, temperature, humidity, etc., the attraction of flies in the field to man, animals, motor vehicles, screens, colours, and traps, the elementary positive reactions, such as those to movement, scent and shade, on which attraction depends, and finally, a discussion of the "feeding ground concept" [*cf. R.A.E.*, B **18** 240; **21** 198; **22** 25; **25** 162].

The following points are taken largely from the part of the author's summary that deals with the attraction of flies in the field: There is as

yet no evidence of attraction to man other than through the external stimuli of movement or scent. Males are attracted whether hungry or not, but females only when very hungry. As regular feeding is necessary for normal reproduction, it follows that man cannot take the place of animals as a host of *G. morsitans*. Most flies that attack a stationary animal do so under the belly, usually well back, and it is suggested that they are primarily attracted by the patch of shade presented. Females with a fat content higher than those that are attracted to man may be attracted to a donkey. Flies are apparently attracted to animals by movement, scent and shade. Over the same route, more flies are attracted to a motor vehicle than to man, and although the percentage of females is no higher, their mean fat content is much greater. A moving lorry apparently attracts females that are ready to feed in spite of a considerable fat content, whereas man attracts only more or less starving females.

Dark colours are markedly more attractive than light ones, at least in the dry season, and this preference is noticeable in the case of both screens and moving natives. A dark blue screen was considerably more attractive than a live donkey. Screens of either black or hessian cloth attract a higher percentage of females than a man or lorry, but black attracts a higher percentage than hessian. The shady side of a black screen attracts more flies and a higher proportion of the fatter females than the sunny side, at least in very hot, dry weather. Various types of traps were tested, including some designed expressly to attract flies into dark shade. Flies entered the traps when the opening was on the shady side quite as readily as when it was underneath, and in the case of one model penetrated into the very dark interior through a slit ¼-inch wide. The percentage of females among flies caught in traps in the dry season was greater than among those caught on man or on a vehicle, and in certain instances slightly exceeded 50. A few figures obtained in the wet season indicated that the percentages in traps and on man are then similar. There is an indication that the strong preference for dark blue or black may be exhibited only under dry season conditions, since a few tests during the rains suggest a preference for hessian. Catches in the traps, which were negligible during the rains and very low during the cooler part of the dry season, rose during August and remained fairly high during September and part of October, but became negligible again after the first heavy rains. The dominant factor determining the reaction to traps appears to be evaporation rate, since the temperature rises as high in the wet season as in August. The falling off of catches in October may be due to the fact that the flies are inactive during the greater part of many very hot days. Restriction of shade in the late dry season is probably a factor contributing to the increased catches at this time. The nature of the attraction exercised by the Harris trap [*cf.* **19** 78] and other somewhat similar models is discussed, and it is thought more likely that the flies are attracted by the patch of shade, or what looks like shade, than that they mistake the trap for an animal ; hunger is not apparently the primary stimulus. The reaction of a fly to stimuli (moving objects, scent, shade and, questionably, bulky objects) is determined largely by its physiological condition, namely, state of nutrition, water content and pregnancy.

Hungry flies are attracted to the better illuminated spots in the forest because hunger increases activity and the positive reaction to light. After feeding, the flies usually return to shade, chiefly for the

processes of primary excretion and concentration of the ingested blood, but actual resting after a meal occupies a few hours at most. Female flies are presumably attracted to shady retreats for larviposition, but this is a rapid process. Active flies normally range continuously through their habitat, and activity is not confined to hungry flies. A forest opening or vlei [*cf.* **25** 160], if evergreen trees are present, and pure mopane (*Copaifera mopane*) forest, when in leaf, are commonly complete habitats for the fly. It appears that the applicability of the feeding ground concept, even in the modified form indicated, depends greatly upon the physical conditions presented by the local forest.

Zumpt (F.). **Tsetsebekämpfung und Bodenerosion.** [Tsetse-fly Control and Soil Erosion.]—*Tropenpflanzer* **42** no. 8 pp. 317–323, 10 refs. Berlin, 1939.

The author briefly reviews measures for the control of tsetse flies (*Glossina*) in Africa and emphasises the danger of soil erosion as a result of clearing.

Gear (J. H. S.) & De Meillon (B.). **Laboratory Investigations of two Cases of Trypanosomiasis contracted in Ngamiland, Bechuanaland.** *S. Afr. med. J.* **13** pp. 233–236. Cape Town, 1939.

An account is given of clinical observations on two cases of sleeping sickness contracted in the southern fly-belt, Ngamiland, Bechuanaland, in 1938 and of laboratory work on the trypanosomes obtained from them, which in their morphology and pathogenicity for laboratory animals were found to resemble *Trypanosoma rhodesiense*. Examination of 130 tsetse flies caught in the southern fly belt showed that all were *Glossina morsitans*, Westw. From these findings, it is concluded that an endemic focus of trypanosomiasis due to *T. rhodesiense* exists in an area further south than any hitherto reported.

De Meillon (B.) & Gear (J.). **Malaria contracted on the Witwatersrand.**—*S. Afr. med. J.* **13** pp. 309–312, 4 refs. Cape Town, 1939.

Several cases of malaria, undoubtedly contracted locally, have recently been reported from the Witwatersrand, and notes are given on four of them, all due to *Plasmodium falciparum*, together with evidence suggesting that they were infected by females of *Anopheles gambiae*, Giles, imported from malarious areas outside. The Anophelines that occur in Johannesburg are zoophilous and only rarely bite man. Several zoophilous species have been taken in houses on the Witwatersrand, but none has been found to contain blood, and *A. gambiae* and *A. funestus*, Giles, the accepted vectors of malaria in South Africa, do not normally occur there owing to the unfavourable climatic conditions. *A. funestus* has never been observed west of the Drakensberg Mountains, but *A. gambiae* is widely distributed in the western and central Transvaal. The principal factor limiting its spread is frost [*cf. R.A.E.*, B **22** 53–54]; a map of the Transvaal is given showing the area that is free from frost and those that have, respectively, 0–50, 50–100 and 100–150 days of frost in the year. In the first, *A. gambiae* is prevalent both in summer and in winter. In the second, it is prevalent in summer but, since it breeds in pools, its local distribution depends on rainfall, which is usually low. In years when the rainfall is heavy, however, it spreads

over the whole area and epidemics of malaria occur. In the third area, it is also present in summer but, owing to the long period of frost, conditions are not normally favourable. It is usually absent from the fourth area. Under exceptional climatic conditions, its incidence is high in all of the first three areas, and it is possible that an overflow from them accounts for the recent finding of both adults and larvae in the fourth area, which includes the Witwatersrand. Laboratory experiments have shown that *A. gambiae* transported to Johannesburg in summer will breed successfully, but it seems unlikely that it can withstand the normal winter there, as it would otherwise have established itself long ago. It is possible that mechanical transport, especially motor cars, played a part in introducing gravid females into the Witwatersrand, but the fact that larvae were found in a stream at some distance from any road suggests that it had also spread directly from endemic areas in northern Transvaal southwards along the courses of rivers and streams. This breeding was discovered in April, but none had been observed in the course of the survey of the same area in February, when cases of malaria were reported. The chances of locally-bred females of *A. gambiae* coming into contact with a gametocyte carrier are small, and no evidence that mosquitos become infected locally has yet been obtained. Moreover, the mean temperature at this time of year is rather lower than the minimum of 61°F. stated to be required for the complete extrinsic development of *Plasmodium falciparum*.

PELTIER (M.), DURIEUX (C.), JONCHÈRE (H.) & ARQUIÉ (E.). **La transmission par piqûre de *Stegomyia* du virus amaril neurotrope présent dans le sang des personnes récemment vaccinées, est-elle possible dans les régions où ce moustique existe en abondance ?**—*Rev. Immunol.* **5** no. 2 pp. 172–195, 12 charts. Paris, 1939. (Abstr. in *Trop. Dis. Bull.* **36** no. 8 pp. 637–638. London, 1939.)

An account is given of experiments carried out in French West Africa in which examples of *Aëdes* [*aegypti*, L.] were repeatedly fed on a number of vaccinated persons, whose blood was shown to contain neurotropic yellow fever virus, and after 2–23 days allowed to bite monkeys [*Macacus rhesus*], none of which became infected. In a second series of experiments, a suspension of the contents of these mosquitos was inoculated subcutaneously into two monkeys and intraperitoneally into two others. One of the last two became infected, but the other three remained healthy. These results confirm the view, also supported by five years' practical experience, that the use of neurotropic yellow fever virus for vaccination does not involve any risk of infection to the general population, even in regions where *Aëdes* is common.

JORDAN (K.). **On some Siphonaptera from tropical Africa and Iraq.**—*Novit. zool.* **41** no. 2 pp. 112–118, 11 figs. Tring, 1938. [Recd. 1940.]

The new species described in this paper include *Xenopsylla bantorum* from field rodents of the genus *Aethomys* in Uganda, and *Ceratophyllus* (*Nosopsyllus*) *medus* from *Mus* (*Rattus*) *norvegicus* in Baghdad, Iraq. *X. bantorum* is closely related to *X. cheopis*, Roths., and was also taken in Kenya, where a few hybrids between the two species were observed.

Uganda : Annual Report of the Medical Department, 1938.—Med. 8vo, 73 pp., 1 fldg map, 1 fldg blue print. Entebbe, 1939. Price 3*s*.

The section of this report dealing with Hygiene and Sanitation includes recommendations by [E. G.] Gibbins (p. 39) on river clearings for the control of *Glossina palpalis*, R.-D., which were offered after a visit of 6 months to the West Nile District, where there were 684 cases of sleeping sickness in 1938. It is practicable to reduce the density of this species to insignificant numbers, but its complete eradication from clearings is not achieved, owing to the impossibility of preventing the passage of an occasional fly along the river. The clearing of bush from strips 10 yards wide on each side of a river, provided that they are of adequate length, is sufficient to control it [*cf.* *R.A.E.*, B **26** 224 ; **27** 41], but the grass in the clearing must be kept short, since a neglected clearing is more dangerous than the original forest. The larger trees may be allowed to remain, provided that they are well-spaced and that none of their branches or foliage is within 15 feet of the ground or the water. The object of the clearing at a crossing should be to ensure that the density of the fly at the point where the river is crossed does not exceed 2 per boy-hour (a figure at which *G. palpalis* is undoubtedly innocuous from the standpoint of sleeping sickness). Strips at least 400 yards wide should be cleared on both sides of the crossing [*cf.* **27** 41]. Small streams that are less than 2 feet wide and have low banks need not be cleared, because the natural fly-density is already below 2 per boy-hour. The ultimate aim should be the clearing of strips along all the larger rivers in the highly populated areas. Cultivation near the river should be prohibited, and a belt of bush should be maintained to act as a screen and also prevent cattle and goats grazing on the river bank from interfering with the growing crops. Logs and dead trees should be removed from the river bed for the length of the clearings.

The Report of the Entomologist [G. H. E. Hopkins] (pp. 62–63) includes a very brief account of the results of several rat and flea surveys. At Tororo, in spite of the numbers of *Mus* (*Rattus*) *rattus* in dwellings, no examples of *Xenopsylla cheopis*, Roths., were found, and *X. brasiliensis*, Baker, was the common flea. *X. bantorum*, Jordan [see preceding paper], which greatly resembles *X. cheopis*, was taken on field rats, and it is suggested that records of *X. cheopis* from areas in Uganda where *M. rattus* was absent [*cf.* **26** 223] refer to this species. The absence of *M. rattus* from all parts of the West Nile District was confirmed. The investigation into the incidence of *Aëdes aegypti*, L., in African dwellings in Kampala was continued. The interiors of 82 huts, selected because they had in their compounds one or more receptacles containing larvae, were examined, but in no case were adults of *A. aegypti* found. It is thought probable that the normal African dwelling is too dark to harbour them.

Eskey (C. R.) & Haas (V. H.). **Plague in the Western Part of the United States. Infection in Rodents, Experimental Transmission by Fleas and Inoculation Tests for Infection.**—*Publ. Hlth Rep.* **54** no. 32 pp. 1467–1481. Washington, D.C., 1939.

Within 10 years of the discovery of plague at the port of San Francisco in 1900, infection was proved to exist among ground squirrels (*Citellus*) in 9 counties of California south of San Francisco

Bay. This region remained the only known permanent focus of infection until 1934, when epizootics occurred among ground squirrels in the Sierra Nevada Mountain areas of California, and a case of plague in man was reported from Oregon. Extensive field investigations carried out since that time have resulted in the discovery of foci of plague in wild rodents in 9 of the western States in addition to California. The infection has been found on the eastern slopes of the Rocky Mountains in two States, but not in the Great Plains area further to the east. Available data would seem to indicate that plague in wild rodents has been gradually spreading eastwards from the Pacific coast. Up to the present it has been demonstrated in 9 species of ground squirrels, which, owing to their wide distribution, the overlapping ranges of the different species, and the tendency of most species to lead a communal existence, have disseminated the infection to a greater extent than any other species of wild rodent. The relative importance of the other rodents in the spread of the disease is briefly discussed. West of the Rocky Mountains, domestic rats are found only in communities on the Pacific Coast, in the valleys of formerly navigable rivers and a few other isolated places. Their absence from most of the territory in which plague exists in wild rodents reduces the hazard to man.

In the course of field surveys in the 11 western States, fleas were collected from over 30,000 small wild animals, chiefly rodents, and over 50 species were obtained. *Citellus beecheyi* harboured an average of over 20 fleas each and marmots (*Marmota flaviventris*) an average of over 10, whereas on some other rodents the average was less than one. All species of wild-rodent fleas showed a certain degree of host preference, and in most cases their natural hosts were limited to one species of rodent or to certain groups of rodents closely related biologically. In spite of this, it was found that some interchange of fleas constantly occurs between all kinds of wild rodents inhabiting the same region. Many rodent fleas were observed on the surface of the ground near the openings of burrows, in the burrow runs and in excavated nests. Although fleas may live apart from their hosts for short periods, they probably do not exist very long in nests that have been abandoned, for they were not found in many excavated nests that failed to show evidence of recent occupation.

A detailed account is given of experiments on transmission [*cf.* *R.A.E.*, B **26** 87] carried out with fleas of 31 species ; some fleas of all species excreted virulent plague bacilli in their faeces after having fed on infected guineapigs, and most of them continued to harbour the organisms throughout their life. A total of 81 fleas belonging to 2 species from domestic rats and 13 from wild rodents transmitted plague by their bites to guineapigs after an extrinsic incubation period that varied from 5 to 130 days. The fleas that transmitted plague in the laboratory included the most prevalent species found infesting the different kinds of wild rodents among which plague has been demonstrated in the western States.

It has been definitely established during recent years that the inoculation of guineapigs with parasites, particularly fleas, collected from wild rodents is preferable to depending on the discovery of plague-infected animals as a means of determining the existence of foci of plague in wild rodents. The accidental discovery that parasites were less likely to infect guineapigs into which they were inoculated when they had been killed by means of chloroform than when they had died

naturally led to experiments which showed that cultures of *Bacillus* (*Pasteurella*) *pestis* are destroyed by chloroform and ether in saturated atmospheres, whereas hydrocyanic acid gas causes only a slight and variable reduction in virulence. Hydrocyanic acid gas was therefore substituted for chloroform for killing parasites before collecting them from their hosts in the field, and since that time, parasites obtained in areas where plague was present have given a greater percentage of positive reactions upon inoculation than when chloroform was used.

Parker (R. R.), Kohls (G. M.), Cox (G. W.) & Davis (G. E.). **Observations on an Infectious Agent from** *Amblyomma maculatum*. —*Publ. Hlth Rep.* **54** no. 32 pp. 1482–1484. Washington, D.C., 1939.

In the course of a survey of local ticks to determine the possible presence in them of agents of human disease, two strains of a rickettsia-like organism were isolated during the late summer of 1937 from guineapigs that had received injections of suspensions of examples of *Amblyomma maculatum*, Koch, collected on cows near Cleveland, Texas. The symptoms in guineapigs, for which the organism is mildly pathogenic, are described. There was complete reciprocal cross-immunity between this infection and Rocky Mountain spotted fever or Marseilles fever, and usually at least partial cross-immunity with endemic typhus, but the disease in question did not agree with any of these diseases in all particulars.

Davis (G. E.). *Ornithodoros parkeri*: **Distribution and Host Data; spontaneous Infection with Relapsing Fever Spirochaetes.**—*Publ. Hlth Rep.* **54** no. 29 pp. 1345–1349, 4 refs. Washington, D.C., 1939.

Records of the occurrence of the tick, *Ornithodorus parkeri*, Cooley, in the United States are given in a table, which shows the State, locality, date, host animal or source, and the stages collected. It has been taken in Wyoming, Montana, Utah, Washington and Colorado. Spirochaetes of relapsing fever were found in ticks from the first two States and six strains have been isolated. The ticks received from the other States were preserved in alcohol and could not be tested. It is the only known likely tick vector of relapsing fever in man in the area in which it has been collected; three cases of the disease, probably contracted in Montana, Utah and Washington in 1927, 1928 and 1932, have been reported. Rodent burrows appear to be the usual habitat of this tick. It has been found on various rodents and a weasel (*Mustela*), and feeds readily on various laboratory animals and on man.

Cherney (L. S.), Wheeler (C. M.) & Reed (A. C.). **Flea-antigen in Prevention of Flea Bites.**—*Amer. J. trop. Med.* **19** no. 4 pp. 327–332. Baltimore, Md, 1939.

The authors describe experiments from which they conclude that there is definite evidence of some sort of "immunity" to flea bites, that the fleas' selection of their victims is not a matter of chance, that this immunity has been definitely demonstrated by them

objectively on a small series of volunteers, and that another group of people very susceptible to flea bites has been actively "immunised" with flea-antigen with very encouraging results.

BARBER (M. A.). **Further Observations (1938) on the *Anopheles* of New Mexico.**—*Amer. J. trop. Med.* **19** no. 4 pp. 345–356. Baltimore, Md, 1939.

An account is given of an Anopheline survey carried out in 1938 in two regions of New Mexico (one in the north and the other in the south-east) and south of El Paso in Texas. In the northern counties of New Mexico, only *Anopheles pseudopunctipennis*, Theo, and *A. maculipennis*, Mg., were taken, but in the south-eastern counties, in addition to *A. pseudopunctipennis* and *A. punctipennis*, Say, which were found in previous surveys [*cf. R.A.E.*, B **21** 196], *A. maculipennis* and *A. crucians*, Wied., were collected. The record of *A. crucians* is the first for the State and possibly for the whole of the Rocky Mountain region. In the Rio Grande valley south of El Paso, only *A. pseudopunctipennis* and *A. punctipennis* were found, although searches for larvae of *A. maculipennis* were made in waters similar to those in which it occurs in various parts of this valley in New Mexico. In the Pecos valley, *A. maculipennis* was found on a tributary but not in the valley of the main river nor on other small tributaries examined. From available evidence, it appears probable that this species has been recently introduced, possibly by road from the Rio Grande valley, where it is abundant. The evidence that *A. pseudopunctipennis* is not a vector of malaria in this region is supported by the fact that the health authorities report a lack of indigenous cases in the Pecos valley, where it is abundant, and by the negative results of the blood examination of 122 persons carried out by the authors at a locality where adults were taken in houses and larvae of this species and of *A. punctipennis* were found in large numbers.

In the second part of the paper, the variability of certain characters in various stages of *A. pseudopunctipennis*, *A. punctipennis* and *A. maculipennis* from various parts of New Mexico are discussed. A list of the Culicine mosquitos found in New Mexico during the summer and autumn of 1938 is given in an appendix.

BATES (M.). **The Use of Salt Solutions for the Demonstration of Physiological Differences between the Larvae of certain European Anopheline Mosquitoes.**—*Amer. J. trop. Med.* **19** no. 4 pp. 357–384, 4 figs., 12 refs. Baltimore, Md, 1939.

In the course of a study made to discover a satisfactory method of rearing Anopheline larvae in the laboratory, it was found that the usefulness of a particular medium or food-stuff could be determined in a period of 3 days at 27°C. [80·6°F.], since, during this time, the larvae pass through the critical process of moulting to the second instar. The technique evolved was subsequently used in the large-scale study described in this paper of the survival of various Anophelines in different solutions of the mineral salts that are found in natural waters, which was undertaken with the object of finding physiological differences in the larvae that might be used as an aid to identification. Newly-hatched larvae of *A. superpictus*, Grassi, and of 6 races of *A. maculipennis*, Mg., were kept for 3 days at 27°C. in solutions

containing sodium chloride, potassium chloride, magnesium sulphate and calcium sulphate, and the percentage surviving was recorded.

The following is taken largely from the author's summary: Race *atroparvus*, van Thiel, seems to have less need for calcium than any of the others studied, a characteristic that differentiates it sharply and enables some larvae to survive in relatively high concentrations of magnesium sulphate without the addition of a calcium salt. In the presence of calcium, it is relatively tolerant of sodium chloride, and it is somewhat more tolerant of potassium chloride than any of the other forms of *A. maculipennis*. Comparison of strains of *atroparvus* from north Germany, England, Portugal, Hungary and Italy showed no differences that seemed significant. The tolerance of race *labranchiae*, Flni., for sodium chloride appeared to be identical with that of *atroparvus*, but it differs sharply from the latter in its calcium requirements and, probably as a consequence, shows a greater mortality in solutions of magnesium sulphate and potassium chloride when no calcium is present. In experiments with magnesium sulphate to which minimum amounts of calcium sulphate were added, its survival was similar to that of races *subalpinus*, Hackett & Lewis, and *maculipennis* (*typicus*). No striking differences were observed between these last two races and race *messeae*, Flni. The material available in the case of *messeae* was inadequate, and although *subalpinus* seems to be consistently more tolerant of sodium chloride than the typical race, the difference is not marked. Race *sacharovi*, Favr, differs from all the others in its greater tolerance of sodium chloride. Experiments with other salts were inadequate to form the basis of any conclusions. The chief characteristic of *A. superpictus* is its inability to survive in media in which there is no readily available supply of calcium. In the presence of calcium, its tolerance for sodium chloride is similar to that of race *atroparvus*. The fact that strains of race *atroparvus* from widely separated parts of Europe did not differ in their tolerances for the various salts studied shows that when differences in tolerances do occur, they probably indicate a profound cleavage in the populations concerned.

BOYD (M. F.) & EARLE (W. C.). **On the Susceptibility of a Neotropical** *Anopheles pseudopunctipennis*, **Theobald, 1901, to Nearctic and Neotropical Strains of** *Plasmodium falciparum*.—*Amer. J. trop. Med.* **19** no. 4 pp. 405–408, 1 ref. Baltimore, Md, 1939.

In continuation of previous studies [*cf. R.A.E.*, B **26** 143], females of *Anopheles pseudopunctipennis*, Theo., reared in Florida from eggs received from Mexico, were fed at the same time as females of *A. quadrimaculatus*, Say, on persons infected with immunologically distinct strains of *Plasmodium falciparum* from Florida and Mexico. Only 1 out of 4 lots of *A. pseudopunctipennis* fed on the Mexican strain and 1 out of 5 fed on the Florida strain became infected, and in both lots the proportion was low and the number of oöcysts per positive stomach was small (less than 30), whereas the nine control lots of *A. quadrimaculatus* fed at the same times all became infected in proportions varying from 14·3 to 100 per cent., and the number of oöcysts in some mosquitos was more than 100. The results suggest that *A. pseudopunctipennis* is not a very efficient vector of *P. falciparum* in the Mexican highlands. *A. quadrimaculatus* appeared to be more susceptible to the Mexican strain than to the one from Florida.

KING (W. V.), BRADLEY (G. H.) & MCNEEL (T. E.). **The Mosquitoes of the Southeastern States.**—*Misc. Publ. U.S. Dep. Agric.* no. 336, 90 pp., 6 pls., 26 figs., 122 refs. Washington, D.C., 1939.

The purpose of this publication, which is based on the literature and on the authors' observations (made chiefly in Louisiana and Florida), is to provide a work of reference for those who have to deal with the mosquitos of the south-eastern part of the United States (as far north as Arkansas, Tennessee and North Carolina). A table showing the distribution of the species and their relative prevalence and economic importance is followed by sections dealing with important literature on mosquitos, their general characteristics and habits, methods of collecting and preserving material, identification, and control, the last section including notes on making surveys, on controlling larvae and adults, and on dealing with the specific problems of control presented by the common malaria vector, *Anopheles quadrimaculatus*, Say, the domestic mosquitos, *Aëdes aegypti*, L., and *Culex fatigans*, Wied. (*quinquefasciatus*, auct.), and the salt-marsh mosquitos (principally *Aëdes sollicitans*, Wlk., and *A. taeniorhynchus*, Wied.). The rest of the paper deals with the particular genera and species found in the region under discussion, giving notes on synonymy, breeding places, distribution, etc., and keys to the adults and fourth-instar larvae.

FROHNE (W. C.). **Anopheline Breeding : Suggested Classification of Ponds based on Characteristic Desmids.**—*Publ. Hlth Rep.* **54** no. 30 pp. 1363–1387, 10 refs. Washington, D.C., 1939.

Details are given of observations made during a year's study of the plant-life of 26 ponds in South Carolina and Georgia, undertaken with a view to evolving a system of pond classification that would be useful to malariologists attempting to define the breeding places of the various species of Anopheline. The term " pond " is defined as a relatively shallow body of quiet water, naturally or artificially impounded and occupied more or less by the larger plants. Particular attention was paid to desmids, which are one-celled or colonial grass-green algae composing two or three families of the order Zygnematales, since they appeared to be especially suitable for indicating environmental differences in mosquito breeding places. They prefer shallow weedy ponds and most species occur in coloured waters with a pH between 5 and 6, such as that in most of the ponds in the region investigated. Species are known from practically all fresh-water habitats, the genera may be recognised at a glance and the species are identifiable by the size and shape of the resistant cell wall. Moreover, many species have been recovered from the guts of Anopheline larvae.

According to the classification tentatively proposed, the ponds are divided into those in which the species of desmids are numerous (average about 35 per pond) and those in which they are few (average about 5 per pond). The first group, in which the waters are almost invariably acid in reaction, is subdivided into the sphagnum, desmid-optimum, and temporary desmid-rich types, and the second, in which the waters are nearly neutral or alkaline, into temporary desmid-poor, *Closterium*-euglenoid and artesian-water types. A key to these six types is given.

Anopheles quadrimaculatus, Say, occurred in large numbers throughout the warm season only in the temporary desmid-poor and the artesian-water types. When present in the desmid-optimum or

temporary desmid-rich types, it was both restricted and inhibited by as yet undetermined, unfavourable environmental factors. In such waters not only did relatively few adults emerge during only part of the breeding season, but the larvae ordinarily occurred in limited areas of the ponds. It has not been found in ponds of the sphagnum type. *A. walkeri*, Theo., was found only in a sub-type of the temporary desmid-rich waters. *A. punctipennis*, Say, appeared to be associated with the desmid-poor group, but also breeds in flowing water. Small streams of the region studied usually drain desmid-rich ponds, a fact that probably explains the relative infrequency of this species near the coast in Georgia. *A. crucians*, Wied., inhabits all six types, but thrives best in desmid-rich waters.

GENEVRAY (J.), TOUMANOFF (C.) & HOANG-TICH-TRY. **Essai de prophylaxie du paludisme par la Prémaline dans une localité du Tonkin et son effet sur le degré d'infection naturelle du vecteur majeur** (*A. minimus* **Theob.**).—*Rev. méd. franç. Extr.-Orient* **17** no. 4 pp. 397–413, 1 fig., 3 pp. refs. Hanoi, 1939.

An account is given of an experiment in which Premaline was administered for more than a year to the population of a coffee plantation in Tonkin where malaria was severe, with a view to determining whether the gametocidal action exercised by this drug would result in a decrease in the number of infected mosquitos captured in houses. This plantation was selected because the vector, *Anopheles minimus*, Theo., was abundant and showed a high rate of natural infection, the population was small and permanent, and there were no animal quarters near, so that the results would not be influenced by the mosquitos being attracted to animals. For the first six months the distribution was made once a week. The spleen, parasite and gametocyte indices were markedly reduced and no cases of fever occurred, whereas in a control population the indices remained high and cases of fever continued to occur. For the second six months the distribution was made every ten days, but cases of malaria then occurred and the parasite and gametocyte indices increased.

An Anopheline survey showed that *A. minimus* was the predominant species in the local fauna, and most of the adults caught belonged to this species. Most of the other species were found in distant animal sheds. The seasonal distribution of the larvae and adults of the species collected is shown in a table. Figures obtained by dissections of *A. minimus* before and during the period of treatment indicate that the number of infected mosquitos was reduced but that the infection rate was still sufficiently high at the end of the experiment to be characteristic of a state of severe endemic malaria, and so too high to allow the suspension or even reduction of the treatment. It is concluded that the situation will remain unchanged unless the numbers of the vector are reduced.

ANDRÉ (M.) & TOUMANOFF (C.). **Etude sur le paludisme et la faune anophélienne dans le centre d'estivage du Mont-Bavi.**—*Rev. méd. franç. Extr.-Orient* **17** no. 4 pp. 415–428, 2 figs., 6 refs. Hanoi, 1939.

An account is given of the establishment of a military summer station on a hill on the slopes of Mont Bavi in the Province of Sontay, Tonkin. Cases of malaria were numerous among the troops during

the summer of 1937, but they became rare from October, when the men were relieved, and comparatively few cases occurred among the new personnel in the summer of 1938. It is concluded that the malaria was not indigenous to the hill and that the cases were relapses and not primary infections, the troops in 1937 having become infected in a bivouac near the foot of Mont Bavi in May. Anopheline surveys carried out in July and November 1937 revealed the presence of larvae of *Anopheles aitkeni*, James, and *A. maculatus*, Theo., but searches for adults in houses and stables gave negative results. Little is known of the resting places of *A. aitkeni*, which has never been found in dwellings or stables, and, in Tonkin, *A. maculatus* is known to visit dwellings only for very short periods during the night and probably then seeks shelter in the surrounding bush. A third survey, undertaken in January 1939, revealed adults of *A. hyrcanus* var. *sinensis*, Wied., *A. annularis*, Wulp (*fuliginosus*, Giles), *A. tessellatus*, Theo., *A. aconitus*, Dön., and *A. splendidus*, Koidz. (*maculipalpis*, auct.) at night near horses in stables, adults of the last-named species and *A. hyrcanus* var. *nigerrimus*, Giles, during the day in barrack buildings, and a single adult of *A. jeyporiensis*, James, which is considered to be the most important vector in Indo-China after *A. minimus*, Theo., at night in the hospital. These species have already been recorded in other localities in the province of Sontay, and since no larvae were found in local breeding places, it is suggested that they were absent or rare, and that the mosquitos had been introduced as a consequence of the growing traffic. It is recommended that possible breeding places should be reduced to a minimum, and that steps should be taken to prevent gametocyte carriers being sent to the station.

TOUMANOFF (C.) & MARTIN (P.). **L'étude des oeufs de quelques anophelinés du Tonkin.**—*Rev. méd. franç. Extr.-Orient* **17** no. 4 pp. 429–434, 3 pls., 5 refs. Hanoi, 1939.

After giving an account of the general structure of Anopheline eggs, the authors describe the eggs of *Anopheles minimus*, Theo., *A. aconitus*, Dön., *A. jeyporiensis* var. *candidiensis*, Koidz., *A. vagus*, Dön., *A. subpictus*, Grassi, and *A. annularis*, Wulp (*fuliginosus*, Giles) from Tonkin, with a view to determining whether examples from the north of the Oriental Region are similar to those of the same species studied in British India [*cf. R.A.E.*, B **19** 167] and in the Netherlands Indies [*cf.* **23** 233]. They conclude that the eggs of females of the same species even from widely separated localities do not differ markedly, and that among the species from Tonkin that have been studied up to the present, it would be difficult to find races distinguishable by the morphology of their eggs.

TOUMANOFF (C.). **Observations sur la fécondité et la longévité de** *A. hyrcanus* **var.** *sinensis* **Wied.**—*Bull. Soc. Path. exot.* **32** no. 7 pp. 726–730, 1 fig. Paris, 1939.

The author describes observations on the egg-laying capacity of females of *Anopheles hyrcanus* var. *sinensis*, Wied., reared in a laboratory in Tonkin and fed on man. In summer, one female, in a lot observed from 13th May, laid 881 eggs in 7 batches over a period of 17 days and died on 20th June ; another, in a lot observed from the end of April, laid 602 eggs in 6 batches over 17 days and died

on 16th June. In winter, a female kept under observation from 13th November until it died on 17th March fed repeatedly throughout its life, but oviposited only once, laying 91 eggs on 4th March. A female that emerged on 13th February laid 305 eggs in 4 batches over a period of 71 days and died on 18th May.

STONE (A.). **Two new** *Aëdes* **from Guam (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **41** no. 5 pp. 162–165, 1 fig. Washington, D.C., 1939.

Descriptions are given of both sexes of *Aëdes pandani*, sp. n., and *A. oakleyi*, sp. n., from Guam. *A. pandani* breeds in the water held in the axils of leaves of *Pandanus*, and causes considerable annoyance to man.

FENG (Lan-chou) & CHUNG (Huei-lan). **The Development of** *Leishmania* **in Chinese Sandflies fed on Dogs with Canine Leishmaniasis.**—*Chin. med. J.* **56** no. 1 pp. 35–46, 2 pls., 12 refs. Peking, 1939.

Since it appears that dogs are the reservoir of human visceral leishmaniasis in the Mediterranean basin [*cf. R.A.E.*, B **28** 17, etc.] and that canine leishmaniasis is prevalent in Peiping, experiments were carried out to determine whether the two sandflies, *Phlebotomus sergenti* var. *mongolensis*, Sinton, and *P. chinensis*, Newst., that attack man and domestic animals in this city and have also been shown experimentally to become infected with the parasite (*Leishmania donovani*) of human visceral leishmaniasis [**26** 148, etc.] would become infected when fed on infected dogs. Sandflies were collected from various parts of the city, and the unfed ones were allowed to feed during the same evening; as a rule both species fed readily, about 80 per cent. of *P. s. mongolensis* and 60 per cent. of *P. chinensis* sometimes sucking blood. The fed sandflies were kept in earthenware pots at room temperature (about 26–32°C. [78·8–89·6°F.]). In this way they could be kept alive for about a week, and dissections were made at intervals during this time.

Both species readily became infected, the percentage varying with the degree of infection of the skin of the dog. Thus, when fed on one showing numerous parasites in the skin, flagellate infections were found in 16 out of 18 examples of *P. s. mongolensis* and 54 out of 58 of *P. chinensis* that contained blood at the time of dissection, and in 0 out of 12 and 3 out of 5, respectively, of those that contained no blood. In *P. s. mongolensis*, the infection dies out with the disappearance of the blood [*cf.* **15** 178], which usually occurs in 2–3 days after feeding at this temperature; no infection was observed in the pharynx or proboscis, even in examples that were re-fed and lived for up to 8 days; infection of the hind-gut was seen in 8 out of 56 infected individuals, but blood was present in all cases, and it is concluded that the flagellates had not actively invaded the hind-gut but were being discharged passively with the undigested blood. In *P. chinensis*, on the other hand, flagellates were numerous in many examples in which there was no trace of blood, although the rate of infection in them was perhaps slightly lower than in those containing blood. This may, however, have been due to the fact that the sandflies that were free from blood on dissection would be those that had imbibed least and, were, therefore, less likely to have become infected. Moreover,

proboscis and pharynx infections were seen in many individuals that had been kept for 5 days or more. Neither these infections nor those seen in the hind-gut depended on the presence of blood. Flagellates were observed in the faeces deposited by one example of this species.

CHUNG (Huei-lan) & FENG (Lan-chou). **Natural Infection of** ***Phlebotomus chinensis*** **in Peiping with** ***Leishmania*** **Flagellates.**—*Chin. med. J.* **56** no. 1 pp. 47–51, 1 pl., 4 refs. Peking, 1939.

In view of the fact that dogs may act as the reservoir of human visceral leishmaniasis [see preceding paper], the authors describe the finding in Peiping in June 1939, in a kennel housing a dog naturally infected with canine general leishmaniasis [*cf. R.A.E.*, B **28** 17], of 16 examples of *Phlebotomus chinensis*, Newst., two of which were naturally infected with flagellates morphologically identical with those of *Leishmania donovani*.

CHANG (T. L.). **Mosquitoes of Hunan Province with special Reference to** ***Anopheles.***—*Chin. med. J.* **56** no. 1 pp. 52–62, 19 refs. Peking, 1939.

An annotated list is given of the mosquitos collected in the course of a survey carried out in Hunan in 1938, more details being given on the breeding places of the five species of Anophelines in view of the increasing prevalence of malaria in the Province. *Anopheles aitkeni*, James, and *A. lindesayi*, Giles, which occurs at high altitudes, are wild species that are practically never found in dwellings and do not appear to be of any importance in the transmission of malaria. *A. maculatus*, Theo., which breeds chiefly in streams and river beds, was not taken in or near dwellings, and its breeding places were not numerous when compared with those of the other Anophelines taken during the survey, so that it is unlikely to play any considerable part in transmission in this region. Larvae of *A. minimus*, Theo., were usually found in hill streams, in pools in their beds and in springs, occasionally in irrigation ditches, and rarely in rice-fields; typically they occur along the edges of running hill streams where a thick growth of filamentous algae protects them from being washed away or devoured by their natural enemies and where there is a certain amount of shade. They are not found in collections of water in thick forest or jungle, but are present in streams shaded by undergrowth. Adults were taken only in small numbers in dwellings, and it seems probable that they enter houses only to obtain a blood meal and leave again after feeding. This species prefers the foothills, is uncommon at high altitudes, and is still rarer in the plains. In southern Hunan, it is the most prevalent Anopheline in the hilly region, and is undoubtedly an important vector of malaria. Dissection revealed oöcysts in two females out of eight collected during the latter part of October in a house where cases of malaria had occurred. *A. hyrcanus* var. *sinensis*, Wied., breeds, in order of decreasing frequency, in rice-fields, pools, ponds and marshes. It generally prefers permanent collections of stagnant water containing much vegetation, such as *Ceratophyllum*, *Myriophyllum*, *Potamogeton* and *Spirogyra*. It was frequently found in dwellings and, particularly, in animal shelters, and was the most abundant Anopheline in the Province, except in the

hilly regions of the south. Dissection of 12 females collected in the house of a family infected with quartan malaria [*Plasmodium malariae*] revealed sporozoites in one and oöcysts in three others. It is undoubtedly one of the most important vectors in the region.

[Dryenski (K.).] **Дрѣнски (К.). The Varieties of** *Anopheles maculipennis* **Meigen and their Relation to the Distribution of Malaria.** [*In Bulgarian.*]—*Mitt. bulg. ent. Ges.* **10** (1938) pp. 31–44, 8 figs. Sofia, 1939. (With a Summary in English.)

The author gives brief descriptions, from material taken in Bulgaria, of the eggs of *Anopheles maculipennis*, Mg., races *maculipennis* (*typicus*), *atroparvus*, van Thiel, *messeae*, Flni., *labranchiae*, Flni., *melanoon*, Hackett, and *sacharovi*, Favr (*elutus*, Edw.), which last he considers a distinct species, and reviews existing information on their breeding places, distribution, hibernation quarters, pairing habits and importance as vectors of malaria.

During investigations in 1935 and 1936 in Petrich (south-western Bulgaria), where malaria is rife, batches of eggs of *A. maculipennis* collected in the field or deposited by females in captivity were examined, and about 96 per cent. belonged to race *maculipennis* (*typicus*). Among females that gave positive results in precipitin tests, 63 per cent. of those taken in inhabited houses had fed on man, and 96 per cent. of those found in animal quarters had fed on animals, chiefly cattle and horses. In Burgas (on the Black Sea), 75, 20 and 5 per cent. of the population of *A. maculipennis* belonged to races *sacharovi*, *maculipennis*, and *messeae*, respectively.

[Sergiev (P. G.), Nabokov (V. A.), Zeĭfert (Yu. A.) & Kachalova (E. K.).] **Сергиев (П. Г.), Набоков (В. А.), Зейферт (Ю. А.) и Качалова (Е. К.). Nouveau pulvérisateur à moteur du système de P. G. Serguiev et V. A. Nabokov " Serna-2 " (constructeur-ingénieur J. A. Zejfert) pour la lutte antilarvaire.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 288–298, 4 figs. Moscow, 1939.

[Kon' (Ya. S.) & Poleshko (G. V.).] **Конь (Я. С.) и Полешко (Г. В.). Résultats des épreuves préalables du pulvérisateur à moteur " Serna-2 " dans la région de Kharkov en 1938.** [*In Russian.*]—*T.c.* pp. 299–302.

In the first paper, a detailed description is given of an apparatus for use in dusting large expanses of water against Anopheline larvae. It is worked by a motor, can be mounted on a boat, a cart, or a motor truck, and in experiments on the shore of a lake was able to blow a cloud of dust far enough to kill all larvae within 100–160 ft. of the bank. A table is given showing the rates at which a mixture of Paris green and road dust (1 : 4) should be applied to water free from vegetation or covered with plants rising above the surface to heights of 4–40 ins.

In the second paper, the cost of dusting an area of 45 acres by means of the apparatus is calculated and shown to be only half that involved in dusting from an aeroplane, and only one-fourth that of dusting by means of the usual hand machinery. The results are also given of tests of the apparatus carried out in 1938 near Kharkov, in which water covering about $2\frac{1}{2}$ acres was dusted with a mixture of Paris green and kaolin (1 : 9) at the rate of 9 lb. per acre. The apparatus was mounted on a car that moved slowly along the shore of the lake

at the rate of 1·2–1·8 miles per hour and in one part at the rate of 5 m.p.h. Almost complete mortality was obtained of Anopheline larvae of all instars in a strip of water 65 ft. wide. Some defects of the apparatus are briefly discussed, and suggestions for improvements are made.

[KEĬRIS (L. M.) & KLOKOV (N. A.).] **Кейрис (Л. М.) и Клоков (Н. А.). Utilisation du vert de Paris non-pulverisé.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 303–305. Moscow, 1939.

In field experiments carried out in the Province of Saratov in a flooded area along a river, complete mortality of larvae of all instars of *Anopheles maculipennis*, Mg., in breeding places of different types was obtained in 8–12 hours by spraying with a suspension of Paris green in kerosene, diluted with water, at the approximate rate of 7·2 oz. Paris green, 1 lb. kerosene and 18 gals. water per acre [*cf. R.A.E.*, B **28** 7]. The kerosene was gradually added to the Paris green and the mixture was taken to the field and diluted on the spot. The spray was applied by means of a knapsack sprayer. As a result of the treatment during the summer of all breeding places in the area, the mosquito population was reduced to a minimum by 1st August. Spraying by this method was only half as expensive as dusting with Paris green from the ground, and also resulted in a saving in time and labour. Moreover, the poison remained on the surface of the water longer than when applied as a dust, and consequently fewer treatments were required.

Effective results were also obtained when crude oil was substituted for the kerosene, the rates used being about 0·9 lb. Paris green and 15 lb. oil in 22 gals. water per acre.

[LETICHEVSKIĬ (M. A.).] **Летичевский (М. А.). Les collections d'eau anophélogènes autour des fabriques de conserves de poisson dans le delta du Volga.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 306–311, 1 map. Moscow, 1939.

In the autumn of 1936, investigations were carried out in the delta of the Volga on the possibility of controlling the breeding of Anophelines. Descriptions are given of the various types of breeding places encountered, but as the area contains a number of fish-curing factories and reclamation work would involve considerable loss to this industry, it is concluded that large-scale operations are impracticable.

[PIKUL' (I. N.), ENIKOLOPOV (S. K.) & KARPOVICH (A. I.).] **Пикуль (И. Н.), Ениколопов (С. К.) и Карпович (А. И.). La copulation des sous-espèces de l'*A. maculipennis typicus, messeae* et *sacharovi* en captivité au Daguestan.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 312–315, 2 figs., 3 refs. Moscow, 1939.

In an experiment in Makhach-kala (Daghestan), eggs of *Anopheles maculipennis*, Mg., races *maculipennis* (*typicus*), *messeae*, Flni., and *sacharovi*, Favr, deposited in the laboratory were placed on water in an insectary that measured 2·5×2·5×2·2 metres and contained plants, sugar syrup and rabbits. Only two batches of eggs were deposited by the resulting females, and both belonged to the typical race. When a similar experiment was carried out in a larger insectary measuring 8×8×6·5 metres, all three races bred continuously for several generations.

[REMENNIKOVA (V. M.).] **Ременникова (В. М.) Quelques données sur la possibilité de la copulation de l'*Anopheles maculipennis messeae* dans une cage.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 316–317. Moscow, 1939. (With a Summary in French.)

In the course of investigations on malaria in the Province of Archangel in 1937 [*R.A.E.*, B **27** 74], special observations showed that adults of *Anopheles maculipennis*, Mg., race *messeae*, Flni., pair under cage conditions. Batches of males and females that emerged on a single day from pupae in the laboratory were confined in small muslin cages and on the following day transferred to a cage measuring 40×40×20 ins., in which they were kept for 3–10 days. The females were then allowed to feed on malaria patients, on 21st–23rd June, and placed without the males in an insectary that contained water and a pig and had a microclimate similar to that of the natural day-time shelters of the mosquitos. Mass oviposition occurred on 30th June, and first-instar larvae were observed on 2nd July. Similar results were obtained in a later experiment.

[MARKOVICH (N. Ya.) & REMENNIKOVA (V. M.).] **Маркович (Н. Я.) и Ременникова (В. М.). Observations sur l'*Anopheles maculipennis* au commencement du printemps dans le nord.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 318–320. Moscow, 1939.

Observations in the spring of 1937 on the behaviour of *Anopheles maculipennis*, Mg., in the town of Sol'vuichegodsk (Province of Archangel) [*cf. R.A.E.*, B **27** 74] showed that the period during which the overwintered females abandoned their hibernation quarters lasted from about 15th April to 21st May. They left their shelters on days when the weather was warm. In the first half of May, females that had fed were taken in day-time shelters. From 26th April onward, numerous unfed females were found in a forest near the town, which indicates that hibernation also takes place out of doors. Some of the mosquitos attacked man and animals in a flooded valley near a river, but this only till 22nd May.

[OLENEV (N. O.).] **Оленев (Н. О.). Sur les ixodides de la partie nord-ouest de l'U.R.S.S.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 321–322, 3 figs., 3 refs. Moscow, 1939. (With a Summary in French.)

A description is given of the female of *Ixodes areolaris*, Olen., [previously briefly characterised under the name *areololaris* (*R.A.E.*, B **25** 200)], based on five examples taken on cattle, two in Leningrad Province, one in Western Province and two in Estonia. The male is unknown.

[ARTEMENKO (V. D.) & VOLYANSKAYA (E. A.).] **Артеменко (В. Д.) и Волянская (Е. А.). Sur les phlébotomes de la partie méridionale de l'Ukraine.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 341–347, 24 figs., 11 refs. Moscow, 1939. (With a Summary in French.)

In the course of investigations on sandflies in the southern Ukraine in 1934–35, *Phlebotomus chinensis*, Newst., was found in Odessa and its environs, as well as in Kherson and the village of Kakhovka on the lower Dnieper. In 1936, 202 sandflies were taken between 1st July and 5th August in a living-room and 5 in a fowl-house in a village

in the basin of the lower Dnieper. Of these, only 21 were males. Examination of specimens prepared from these males and from 79 females showed that 5 males and 1 female were *P. chinensis*; the rest were apparently *P. sergenti*, Parr., as indicated by the structure of the male external genitalia and the spermathecae of the females, but in view of certain characters in the morphology of the males and in the structure of the pharynx of the females, the authors consider that they possibly represent a new subspecies. Both sexes are described.

[Shchurenkova (A. I.).] **Щуренкова (А. И.). Sur les variétés du** *Phlebotomus sergenti*—**var.** *alexandri* **et var.** *mongolensis* **(Sinton, 1928).** [*In Russian.*]—*Med. Parasitol* **8** no. 3 pp. 348–356, 4 figs., 14 refs. Moscow, 1939. (With a Summary in French.)

In view of discrepancies in the literature regarding the characters used for the identification of *Phlebotomus sergenti* var. *mongolensis*, Sinton, and *P. alexandri*, Sinton, which the author regards as a variety of *P. sergenti*, Parr., a critical survey is given of descriptions and illustrations by various workers, chiefly Russian, and a comparison is made of the characters of both sexes of the two forms as represented in Tadzhikistan, where *mongolensis* is found only at considerable altitudes, while *alexandri* is widely distributed.

[Kalita (S. R.).] **Калита (С. Р.). Découverte de l'***Anopheles maculipennis subalpinus* **Hack. et Lewis sur la côte de la Mer Noire, dans le territoire de Krasnodar.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 360–361, 1 fig. Moscow, 1939. (With a Summary in French.)

In the Russian Union, *Anopheles maculipennis*, Mg., race *subalpinus*, Hackett & Lewis, has hitherto been recorded from the central part of the northern slopes of the Caucasus, from localities on the Caspian in Azerbaijan and Daghestan, and from along the Black Sea coast of Georgia. In June 1938, three batches of eggs of this race were obtained from females collected in a cow-shed near Adler, further north on the Black Sea coast. The eggs are described.

[Zvyagintzev (S. N.).] **Звягинцев (С. Н.). Un cas de ponte de l'** *Anopheles hyrcanus* **Pall. dans un cuveau rempli d'eau.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 361–362. Moscow, 1939.

Second-instar larvae of *Anopheles hyrcanus*, Pall., which usually breeds in water covered with vegetation, were observed on 25th August 1936 in a wooden tub in a vegetable garden near Derbent, in Daghestan. The water in the tub had been taken 5 or 6 days previously from an irrigation ditch, was slightly turbid and had a temperature of 23·5–25°C. [74·3–77°F.]. The number of larvae gradually decreased, and only about 7 per cent. of them gave rise to adults, on 4th September. In the field, larvae of *A. hyrcanus* occurred in rice-fields and flooded irrigation ditches, together with those of *A. maculipennis*, Mg., races *maculipennis* (*typicus*), *messeae*, Flni., and *sacharovi*, Favr, and *A. plumbeus*, Steph.

[Pivovarov (V. M.).] **Пивоваров (В. М.). Méthode de lutte contre les mouches au moyen des poudres.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 362–363. Moscow, 1939.

Successful results in the control of flies [*Musca domestica*, L.] in buildings were obtained in Voronezh by lightly dusting the walls,

ceiling, doors, window frames and sills, and also the electric lights and fittings, with a mixture of 94–95 parts of finely powdered sugar and 5–6 parts of sodium arsenite or arsenic trioxide, applied at the rate of 0·5 gm. per 10 sq. ft. The flies readily fed on the sugar and began to die in numbers 2–3 hours after the dust was applied. When the proportion of the poison in the mixture was reduced to 2–3 parts, only 50 per cent. of the flies were killed in two days. On the other hand, increasing it to 8–12 parts did not appreciably increase the effectiveness of the mixture. Each component was first ground separately, and 1–2 per cent. by weight of an aniline dye was added to the mixture, so that dusted surfaces could easily be distinguished. The dust was then again thoroughly ground in a mortar. Another method was to dissolve the arsenic and the dye in a thick sugar syrup and then evaporate it until a dry layer of poisoned sugar remained, which was ground into a fine powder.

[Asnes (S. M.).] **Аснес (С. М.). Résultats des observations sur le peuplement par la gambousie des rizières du kolkhoz " Azovris ", district de Mariupol, région de Stalino, en 1938.** [*In Russian.*]—*Med. Parasitol.* **8** no. 3 pp. 364–365, 2 graphs. Moscow, 1939.

In experiments carried out in July 1938 in a rice plantation in the south-east of the Ukraine, some 800 adults of *Gambusia* were released in plots covering an area of about 900 sq. yards and densely infested by larvae of *Anopheles maculipennis*, Mg. Surveys made every five days showed that the numbers of larvae of this Anopheline and other mosquitos began to decrease soon after the introduction of *Gambusia*, and did so rapidly when the young minnows were produced. First-instar larvae were, however, constantly present, as the eggs were evidently not destroyed by the fish. In control plots, larvae of all instars and pupae were numerous throughout the period of the experiments.

The author concludes that *Gambusia* would control the larvae of *A. maculipennis* in rice plantations if released in June at the rate of 2–3 fish per 10 sq. ft.

Papers noticed by Title only.

Strickland (C.) & Roy (D. N.). **Ticks found on Man** [17 records from India, including 7 identified species].—*Indian J. med. Res.* **27** no. 1 pp. 251–252, 4 refs. Calcutta, 1939.

Raynal (J. H.), Fournier (J.) & Velliot (E.). **Research on Typhus in Shanghai.**—*Chin. med. J.* **56** no. 1 pp. 11–28, 6 charts, 15 refs. Peking, 1939. [For shorter account see *R.A.E.*, B **28** 13.]

Tokunaga (M.). **Japanese Biting Midges of** *Bezzia* **and** *Palpomyia* **(Ceratopogonidae, Diptera)** [descriptions of species from Japan, Sakhalin and Formosa, including new ones of both genera from Japan].—*Tenthredo* **2** no. 3 pp. 273–313, 45 figs., 7 refs. Shinomiya, Yamashina, Kyoto, 1939.

da Fonseca (F.). **Descrição do macho de** *Flebotomus arthuri* **Fonseca 1936 (Diptera, Psychodidae).** [Description of the Male of *Phlebotomus arthuri*, Fonseca, from São Paulo.]—*Mem. Inst. Butantan* **12** pp. 181–184, 1 pl., 8 refs. S. Paulo, 1939. [*Cf. R.A.E.*, B **25** 50.]

Basu (B. C.) & Sundar Rao (S.). **Studies on Filariasis Transmission.**—*Indian J. med. Res.* **27** no. 1 pp. 233–249, 4 graphs, 7 refs. Calcutta, 1939.

The following is based on the authors' summary: Batches of laboratory-bred examples of *Culex fatigans*, Wied., were fed between 10 and 11 p.m. on cases of filariasis showing embryos of *Filaria (Wuchereria) bancrofti* in the peripheral blood, and immediately after feeding were exposed to 36 different combinations of atmospheric temperature and relative humidity [*cf. R.A.E.*, B **18** 137, 140]. At 100°F., with humidities between 50 and 100 per cent., transmission does not seem possible because the mosquitos do not survive long enough to become infective. At 90°F., no infection was seen at humidities between 50 and 70 per cent., but a fairly high percentage of infectivity was observed at humidities between 80 and 100 per cent. among mosquitos that survived. At 80°F., a very high percentage of the mosquitos surviving became infected at 100 per cent. humidity and all did so at 90 per cent. humidity, so that these would appear to be the optimum conditions. At 70°F., a fairly high percentage became infected at humidities between 70 and 100 per cent., but none at lower humidities. At 60°F., a very low percentage became infected at humidities between 70 and 100 per cent. and none at lower humidities. The minimum times taken for the complete development of the filarial embryos and their appearance in the proboscis of the mosquitos were 9, 10, 20 and 47 days at 90, 80, 70 and 60°F., respectively. A minimum of 12 microfilariae per 0·2 cc. blood was found to be infective to the mosquito. The highest infection was observed when the count was 101–150 per 0·2 cc.; below and above this, infectivity decreases. The age of the donor is also of importance; the proboscis infection rate was 9–10 per cent. with the age groups of 11–20, 21–30 and 31–40 years, 28 per cent. with that of 41–50 years, and 63 per cent. with that of 51–60 years.

Hu (S. M. K.). **The House-frequenting Behaviour of** *Anopheles hyrcanus* **var.** *sinensis* **Wiedemann in the Shanghai Area, Part 2—Time of Exit.**—*Lingnan Sci. J.* **18** no. 2 pp. 133–142, 1 pl., 5 graphs, 9 refs. Canton, 1939.

In continuation of previous experiments on the behaviour of *Anopheles hyrcanus* var. *sinensis*, Wied., in the Shanghai area [*R.A.E.*, B **23** 232], collections were made at intervals of two hours from 1 p.m. on 15th July to 1 p.m. on 20th July 1937 in a tent of mosquito netting erected outside and attached round the doorway of a shed occupied at night by a cow, to determine the time of day when this species left the shed. The technique of the experiment is described, and the numbers leaving within each two-hour period are shown in a table.

The following is taken largely from the author's summary: The Anophelines began to leave the shed at dusk and flew out more or less continuously for most of the night. On most days, more were found to make their exit within the two hours after sunset (7 p.m.) than at any other time. Most of the Anophelines that were still in the shed about sunrise (5 a.m.) seemed to prefer to remain there during the day, since few were found to fly out between 5 a.m. and 5 p.m.

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Hu (S. M. K.). **Studies on the Susceptibility of Shanghai Mosquitoes to experimental Infection with *Wuchereria bancrofti* Cobbold. VII. *Culex vorax* Edwards.**—*Peking nat. Hist. Bull.* **13** pt. 4 pp. 287–292, 3 refs. Peiping, 1939.

During 1934–35 and 1937, experiments similar to those already noticed [*R.A.E.*, B **27** 124, etc.] were undertaken in Shanghai to determine the susceptibility to infection with *Filaria* (*Wuchereria*) *bancrofti* of females of *Culex vorax*, Edw., reared from larvae collected locally. Of 29 mosquitos examined, 7 showed no infection, 1 dissected 17 days after the infecting feed contained only dead immature larvae, and 21 dissected 12–23 days after the infecting feed contained infective larvae. In 8 of the 21 mosquitos the infective larvae were dead, and in only 6 (including 2 of these 8) were all the larvae unaffected by chitinisation. Some of the infective larvae were affected by chitinous encapsulation while they were still alive. Five of the mosquitos containing infective larvae also contained immature stages, which were dead and more or less chitinised. It is concluded that the extensive chitinisation is likely to affect adversely any part that *C. vorax* may play in the transmission of *F. bancrofti* in the Shanghai region.

Glick (P. A.). **The Distribution of Insects, Spiders and Mites in the Air.**—*Tech. Bull. U.S. Dep. Agric.* no. 673, 150 pp., 5 pls., 2 figs., 11 graphs, 79 refs. Washington, D.C., 1939.

A detailed account is given of investigations on the aerial distribution of Arthropods carried out in north-eastern Louisiana during 1926–31 and in northern Mexico in 1928 by means of screens smeared with adhesive attached to aeroplanes [*cf. R.A.E.*, A **28** 79]. Among the Diptera collected were a number of blood-sucking species, those taken in Louisiana including 11 examples of *Anopheles quadrimaculatus*, Say, at altitudes up to 1,000 ft., 4 of *Aëdes vexans*, Mg., of which one taken at 5,000 ft. was alive when removed from the screen, 32 undetermined examples of *Culicoides* at altitudes of from 200 to 13,000 ft., and 48 examples of species of *Simulium* at altitudes of up to 5,000 ft. One flea (*Pulex irritans*, L.) was taken at 200 ft.

Stage (H. H.) & Yates (W. W,). **Ground Beetles predatory on the Eggs of *Aëdes* Mosquitoes.**—*Proc. ent. Soc. Wash.* **41** no. 6 pp. 204–206. Washington, D.C., 1939.

The breeding areas of most species of *Aëdes* in the Pacific Northwest furnish suitable habitats for numerous species of ground beetles for periods of 8–10 months in the year. The soil may be clay, gravel or sand, but it is invariably well covered with humus of leaves, grass and dead wood and is usually sheltered from wind and sun by brush and trees. In studies on the viability of eggs of *A. vexans*, Mg., and *A. lateralis*, Mg. (*aldrichi*, D. & K.) [*cf. R.A.E.*, B **27** 156, 231], it was found that parts of egg-shells were almost as numerous as eggs in the sifted soil, and that a proportion of the eggs stored in boxes on the ground and loosely covered with leaves had been reduced to mere shells. Small ground beetles sometimes sheltered among the protecting leaves. During 1937 and 1938, collections were made from various localities of invertebrates, particularly Carabid beetles, living on the ground. When eggs of *Aëdes* were placed in boxes with them, some species of Carabids devoured 2–6 eggs per week and others 8–15.

Other species of Carabids and beetles of various other families refused to feed on them at all. A flat-worm, *Planaria maculata*, was, on rare occasions, observed feeding on mosquito larvae in the laboratory, devouring 1–2 larvae per day.

McDaniel (E. I.). **Larvicides and Contact Sprays used in Mosquito Control.**—*Quart. Bull. Mich. agric. Exp. Sta.* **22** no. 1 pp. 32–34. East Lansing, Mich., 1939.

A somewhat popular account is given of measures that may be undertaken for the control of mosquitos, particularly the use of pyrethrum extract in oil emulsion as a spray against the larvae [*cf.* *R.A.E.*, B **23** 205] or against the adults when it is desired to protect gatherings of people out-of-doors [*cf.* **24** 34].

Carpenter (S. J.). **The Mosquitoes of Arkansas.**—4to [4+] 89 pp. multigraph, 31 figs., 1 diagr., 48 refs. Little Rock, Ark., Ark. State Bd. Hlth., 1939.

Ideal conditions for some of the most troublesome mosquitos in the United States are found in Arkansas. In some lowland areas, the abundance of the species that breed in the pools left by the receding floods is such as to render practically impossible the planting, cultivation and harvesting of crops. Land values in some localities are seriously reduced, and industrial development in the eastern part of the State is hindered by the numbers of pest mosquitos and of *Anopheles quadrimaculatus*, Say, the chief vector of malaria. Although the settlement of lowland areas, with the resulting improvement of the land and the institution of flood control measures, has reduced the breeding places of some mosquitos, the multiplication of *A. quadrimaculatus* has been increased by such activities as the wet cultivation of rice, which has also provided conditions that promote the breeding of *Psorophora columbiae*, D. & K. [*cf.* *R.A.E.*, B **27** 257]. The development of the oil industry in the south has led to the dumping of salt water into small streams and created conditions favourable for the production of the salt-marsh mosquitos, *Aëdes sollicitans*, Wlk., and *A. taeniorhynchus*, Wied., which are abundant enough at times to interfere with outdoor work. The establishment of villages and towns, with the accompanying pollution of water and the increase in artificial collections of water, has brought about more favourable conditions for the common house mosquito, *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and for *A. aegypti*, L. Since successful control of mosquitos cannot be carried out without a knowledge of their habits and distribution, investigations were begun in 1937 and the results obtained in almost two years are given in this paper. Collections were made in every type of area in the State and from approximately two-thirds of the counties ; 34 species were taken, excluding 8 species recorded by other workers. Keys are given to the adult females of the 42 species and to the larvae of 41.

The greater part of the paper (pp. 31–68) deals with the individual species, notes being given on the female characters, larval morphology, distribution, breeding habits, and habits and importance of the adults. This is preceded by the keys and by sections on the general habits of mosquitos, on the methods and technique of collecting, preserving, rearing and mounting larvae, of obtaining oviposition, of collecting

adult mosquitos, of pinning and storing specimens of adults, and of identifying adults and larvae, and on the seasonal occurrence of the different species in Arkansas. It is followed by a discussion on control by natural factors and by artificial means, and by the description of an experiment on the flight range of *Anopheles quadrimaculatus*, which indicated that the usual distance of dispersion is slightly less than $\frac{3}{4}$ mile.

RUSSELL (P. F.) & MOHAN (B. N.). **Experimental Infections in** *Anopheles stephensi* **(type) from contrasting Larva Environments.**—*Amer. J. Hyg.* **30** (C) no. 2 pp. 73–79, 13 refs. Lancaster, Pa., 1939.

The experiments described were undertaken to determine whether the ability of Anopheline mosquitos to transmit malaria could be reduced by modifying the character of their breeding places. Females of *Anopheles stephensi*, List., obtained from larvae reared in tap water and in water containing cow dung, respectively, were allowed to feed on persons infected with *Plasmodium falciparum* and dissected after an incubation period of about 8 days. The average sporozoite rates were 37·1 per cent. for batches of females of the first series and 29 per cent. for those of the second. Thus, although the ability of females of the first series to transmit the disease would appear to be slightly greater, the high rate in the second precludes the idea of making any practical use of the pollution of breeding places as a means of reducing the susceptibility of Anophelines to malaria infection.

WEHR (E. E.) & CAUSEY (O. R.). **Two new Nematodes (Filarioidea :** *Dipetalonematidae*) **from** *Rana sphenocephala*.—*Amer. J. Hyg.* **30** (D) no. 2 pp. 65–68, 6 figs. Lancaster, Pa., 1939.

CAUSEY (O. R.). **Development of the Larval Stages of** *Foleyella brachyoptera* **in Mosquitoes.**—*T.c.* pp. 69–71, 5 refs.

In the first paper, descriptions are given of *Foleyella brachyoptera*, sp. n., and *F. dolichoptera*, sp. n., from *Rana sphenocephala* in Florida. The latter is the unidentified species found in *R. sphenocephala* and *R. pipiens* and used in experiments already noticed [*R.A.E.*, B **27** 178], and the former is the species used in the experiments described in the second paper. Dissection of 19 mosquitos 20 days after they had fed on the infected frog revealed mature larvae of *F. brachyoptera* in 8 out of 9 females of *Culex fatigans*, Wied., 3 out of 5 of *C. pipiens*, L., and 4 out of 5 of *Aëdes aegypti*, L. As only immature larvae were found in females of *C. fatigans* dissected before this time, it appears that development of this species of *Foleyella* takes longer than that of the other two species observed [*cf.* **27** 178, 231]. The effect of infestation on the mosquitos is briefly discussed.

KUMM (H. W.) & RUIZ (S. H.). **A Malaria Survey of the Republic of Costa Rica, Central America.**—*Amer. J. trop. Med.* **19** no. 5 pp. 425–445, 11 maps, 6 refs. Baltimore, Md., 1939.

After describing the country, its topography and rainfall, the authors give an account of a malaria survey carried out in Costa Rica in 1938, in which more than 9,000 children from 168 localities were examined, and of an Anopheline survey carried out at the same time, in which 13,393 examples from 175 localities were identified. Altitude produces

great variations in climate between localities that are relatively close together. In the high upland plateau, which is the most densely populated part of the country, malaria occurs but rarely and then only in the form of brief epidemics. It is, however, highly endemic in the coastal lowlands at altitudes below 1,000 ft., where bananas, one of the chief agricultural products of the country, are grown. Occasional severe epidemics are known to have occurred fairly high up in the valleys of two of the rivers.

The following list of the Anophelines collected shows the numbers of examples and of localities in which each species was taken: *Anopheles albimanus*, Wied. (8,428 and 91), which was taken chiefly at altitudes below 1,000 ft.; *A. apicimacula*, D. & K. (451 and 47), *A. argyritarsis*, R.-D. (1,474 and 94), *A. eiseni*, Coq. (84 and 16) and *A. pseudopunctipennis*, Theo. (1,986 and 63), all of which were taken at sea level and at altitudes up to and over 3,000 ft.; *A. neomaculipalpus*, Curry (387 and 11), *A. punctimacula*, D. & K. (173 and 14), *A. strodei*, Root (115 and 16), *Chagasia bathanus*, Dyar (90 and 20), *A. tarsimaculatus*, Goeldi (84 and 4), *A. vestitipennis*, D. & K. (77 and 3), and *A. triannulatus*, Neiva & Pinto (*bachmanni*, Petrocchi) (29 and 1), all of which are typical lowland species rarely found above 1,000 ft.; *A. chiriquiensis*, Komp (7 and 1), which was taken at an altitude above 3,000 ft.; and *A. neivai*, H., D. & K. (7 and 2) and *A. anomalophyllus*, Komp (1 and 1), both of which were taken at altitudes above 1,000 ft. A comparison of the relative abundance of the species in 47 localities where the spleen index of the children was 15 per cent. or more and in 19 where it was zero, showed that *A. albimanus* was the commonest species in the former and *A. argyritarsis* in the latter, and that *A. pseudopunctipennis* was present in only about half of the highly malarious villages. Dissection of 559 females of *A. albimanus*, 20 of *A. vestitipennis*, 7 of *A. pseudopunctipennis* and 7 of *A. punctimacula* revealed a single salivary gland infection, in *A. albimanus*. This was the species most commonly observed in houses; *A. argyritarsis* and *A. pseudopunctipennis*, though frequently found as larvae, were only rarely taken as adults.

GABALDON (A.). **On *Anopheles mattogrossensis* from Venezuela with Description of the Male.**—*Amer. J. trop. Med.* **19** no. 5 pp. 457–460, 1 fig., 2 refs. Baltimore, Md., 1939.

Anopheles mattogrossensis, Lutz & Neiva, was taken in small numbers at the port of La Ceiba on Lake Maracaibo, Venezuela, in 1937 and 1938. Larvae were not found in the large swamps in the vicinity, but only in a drainage ditch and in a small rain-water pool in open country, both of which contained vertical vegetation, chiefly grass; they were associated with the larvae of *A. triannulatus*, Neiva & Pinto (*bachmanni*, Petrocchi), *A. darlingi*, Root, *A. punctimacula*, D. & K., and *A. tarsimaculatus*, Goeldi. *A. mattogrossensis* attacks man, but on account of its scarcity it is unlikely to be concerned in the transmission of malaria. The hitherto unknown male is described.

KING (W. V.). **Varieties of *Anopheles crucians* Wied.**—*Amer. J. trop. Med.* **19** no. 5 pp. 461–471, 2 figs., 3 refs. Baltimore, Md., 1939.

Descriptions are given of the larva, pupa and adults of both sexes of *Anopheles crucians* var. *bradleyi*, n., which is the coastal or

brackish water form of *A. crucians*, Wied., that has been recognised in the United States for several years [*cf. R.A.E.*, B **13** 20; **20** 123], and of *A. crucians* var. *georgianus*, n., which is the inland race resembling it that has been found in Georgia [**27** 191]. Notes are also given on the characters of the larva and the male terminalia of the typical *A. crucians*, and the characters distinguishing the larvae of the three forms are summarised.

VARGAS (L.). **Anofelismo sin Malaria en Mexico.** [The Occurrence of Anophelines in the Absence of Malaria in Mexico.]—*Medicina* **19** no. 346 pp. 334–339, 23 refs. Mexico, D.F., 1939. (With a Summary in English.)

Data are given showing that although Anophelines are common in a locality in the district of Lerma, State of Mexico, cases of malaria are extremely rare. All the Anophelines taken in houses in the locality belonged to the form described by Hoffmann as *Anopheles maculipennis* var. *aztecus* [*R.A.E.*, B **23** 193]. The author considers that *A. maculipennis*, *sens. lat.*, is represented in North America by two races, *occidentalis*, D. & K. [**23** 235] and *aztecus*, both of which he is inclined to regard as distinct species. Characters are given distinguishing the eggs, larvae and adults of the two forms, and the larva and adults of *aztecus* are described. It occurs in California and New Mexico, and in various localities in Mexico.

VARGAS (L.). **Datos acerca del** *A. pseudopunctipennis* **y de un** *Anopheles* **nuevo de California.** [Data on *A. pseudopunctipennis* and on a new *Anopheles* from California.]—*Medicina* **19** no. 347 pp. 356–362, 9 refs. Mexico, D.F., 1939. (With a Summary in English.)

The distribution of *Anopheles pseudopunctipennis*, Theo., is summarised from the literature. It occurs from California to Argentina and has been taken at altitudes of up to about 7,600 ft. Data are given on the morphology of the males taken in the State of Morelos, Mexico, and of the eggs that were obtained in the laboratory, and they are compared with those recorded in the literature. The author considers that the eggs described by Herms & Frost [*cf. R.A.E.*, B **20** 220] and attributed by them to *A. pseudopunctipennis* represent a distinct species, which he names *A. boydi*, sp. n. Characters are given differentiating the eggs of *A. boydi* from those of *A. pseudopunctipennis*. The adults present no striking morphological differences. *A. boydi* occurs in California, and is of no importance in the transmission of malaria. A key to the eggs of the Californian species of *Anopheles* is appended.

MARNEFFE (H.), GASCHEN (H.) & NGUYEN-BA-TUNG. **Contribution à l'étude du paludisme du delta tonkinois.**—*Arch. Inst. Pasteur Indochine* **7** no. 27 pp. 263–296, 1 fldg plan, 2 graphs, 7 refs. Saigon, 1938. [Recd. 1939.]

The delta region and the sea coast of Tonkin are considered to be almost free from malaria, but it is of importance locally, although, unlike the malaria of the mountain regions, it is relatively benign

and takes the form of epidemic outbreaks of short duration that are usually seasonal. An account is given of a study of malaria in the town of Haiduong in the delta region carried out over a period of more than three years and of epidemics observed in a large village (Binh-Ha) in the neighbourhood. Anophelines were found to breed chiefly in domestic pools (containing waste water), in ditches and marshes, at the edges of streams and rivers, and in rice-fields. Larvae and adults of several species were taken, but *Anopheles hyrcanus* var. *sinensis*, Wied., and *A. vagus*, Dön., constituted 89·4 and 7·6 per cent., respectively, of the former and 53·3 and 37·9 per cent. of the latter. A comparison of the relative percentages of the species taken in dwellings and buffalo sheds showed that *A. hyrcanus* var. *sinensis* constituted 54·7 per cent. of the adults in dwellings and 36 per cent. of those in the sheds, whereas with *A. vagus* the proportions were almost exactly reversed. *A. hyrcanus* var. *nigerrimus*, Giles, and *A. tessellatus*, Theo., were more frequent in the dwellings than in the sheds, whereas the reverse was true of *A. aconitus*, Dön. Of 1,168 Anophelines dissected between December 1933 and May 1936 none was infected, but further dissections during May and June 1936, when there was a recrudescence of malaria, revealed 29 infections among 731 examples of *A. h. sinensis* (17 in the salivary glands, 10 in the stomach and 2 mixed infections), 1 salivary gland infection among 70 examples of *A. h. nigerrimus* and 1 mixed infection among 52 examples of *A. tessellatus*. Negative results were obtained with 4 examples of *A. aconitus* and 17 of *A. vagus* taken at the same time, and with 334 further dissections carried out after 15th June. The three Anophelines found infected are usually considered to be of little or no importance as vectors, and there is no point in the Tonkin delta, even though it be free from malaria, where *A. h. sinensis* is not abundant. The incidence of malaria in Haiduong is on the whole slight, but in one particular quarter of the town it is very marked and unevenly distributed. Various hypotheses that might account for its occurrence are discussed, and it is concluded that it is due to the high density of *A. h. sinensis*, produced by climatic conditions more favourable than elsewhere to Anopheline breeding combined with an ample supply of gametocyte carriers provided by the continuous movement of a large part of the population to and from malarious areas, the most malarious quarter of the town being that most likely to shelter large numbers of infected persons and the one in which most of the infected mosquitos were found.

The first outbreak of malaria investigated at Binh-Ha lasted from October 1935 until the following March, and the second, which was much less severe, occurred in the autumn of 1936. The usual Anopheline fauna of the delta was present, *A. h. sinensis* and *A. vagus* again predominating in both larval and adult collections. Dissection showed 10 infections among 646 of the former, including 4 in the salivary glands, and 1 gland infection in 218 of the latter. It was during the first outbreak in this village that the rôle of *A. h. sinensis* as a vector was first recognised [*R.A.E.*, B **25** 86]. The establishment of malaria was probably due to the same causes as in Haiduong, for movement of the population to and from malarious areas has taken place since 1931–32, and it would seem that a particularly large number of persons returned in 1935 and that, since this year was wetter than usual, it was favourable for the multiplication of Anophelines. The difficulty of devising any anti-malaria measures that would be economically practicable is discussed.

CAMBOURNAC (F. J. C.). **Como os Mosquitos transmiten as sezões em condições naturais.** [The Manner in which Mosquitos transmit Malaria in natural Conditions.]—*Naturalia* **2** no. 3–4 pp. 151–159, 8 figs. Lisbon, 1938. [Recd. 1939.]

This popular account of the transmission of malaria by Anophelines includes a few notes on conditions in Portugal, where the chief vector is *Anopheles maculipennis*, Mg., race *atroparvus*, van Thiel, which occurs throughout the country [*cf. R.A.E.*, B **26** 217]. It is not common in Lisbon and rarely attacks man there, but it is abundant in the rice-growing districts, where owing to the scarcity of domestic animals, it enters houses and is responsible for endemic malaria, sometimes of a serious character. Race *maculipennis* (*typicus*) also occurs in Portugal, but is zoophilous and rarely attacks man. In certain northern frontier districts, mostly in the region of the Douro and its tributaries, Anophelines breed in the pools formed in midsummer when rivers and brooks cease flowing. The rice-fields are under water from March to September if the rice is sown, and from June to September if it is transplanted, and Anopheline breeding is intense in them during these periods.

DE MEILLON (B.). [**Report of the**] **Department of Entomology.**—*Rep. S. Afr. Inst. med. Res. 1938* pp. 33–38, 6 refs. Johannesburg, 1939.

Much of the information contained in this report has been noticed from other sources. Daily spraying previously recommended against adult Anophelines in huts on the Nkana mine in Northern Rhodesia appeared to give most satisfactory results in 1937, as the numbers of mosquitos per hut and the number of cases of malaria were both reduced. The suspicion that the mild season had contributed to this result, however, was proved correct for, during the summer of 1938, daily spraying had little effect on the incidence of the disease although the number of mosquitos per hut was reduced to 0·1. On the other hand, in one month at least, very nearly half the infections were contracted beyond the area of control. From this observation and from experience in Natal, it would appear that when the salivary gland infection rate is low and the breeding of the vector is not prolific, daily spraying produces beneficial results. For some years, rigorous larval control measures have been in operation within half a mile of the Luanshya mine, and a very costly and efficient system of drainage has been instituted. The extensive flight range of the vectors observed at Nkana [*cf. R.A.E.*, B **26** 120] was again noted at Luanshya, and sporozoite rates of 6 per cent. in *Anopheles funestus*, Giles, and 5 per cent. in *A. gambiae*, Giles, were obtained within the controlled area. It thus appears that a distance of half a mile is not adequate in southern Africa. A relative increase in the numbers of *A. gambiae* was observed in the drained area, and it is recalled, in this connection, that the breeding places of *A. gambiae* are largely man-made, whether they result from the disturbance of the soil by surface workings or from drainage designed to prevent the breeding of *A. funestus*.

An outbreak of midges [*Chironomus*] occurred in October in the lake in the district of Port Elizabeth in which they had previously been controlled by increasing the salinity [**26** 94], but investigation showed that the outbreak was limited and that the continued high

salinity of over 4 per cent. was still effective. An investigation into the food of the sea-water fish that had been introduced into the lake in 1935 showed that two species that are bottom-feeders live almost exclusively on midge larvae. It is probable that all fish of this type that have been placed in the lake feed on midge larvae, and it was therefore recommended that they be protected and the salinity not increased further. An outbreak of midges occurred at Observatory, Johannesburg, in December; breeding was discovered in a large municipal reservoir and it was recommended that fish be introduced or the reservoir covered in to prevent the access of adult midges.

Re-examination of fleas collected from *Desmodillus auricularis* in South Africa and recorded as *Xenopsylla cheopis*, Roths., showed that they are this species and not *X. bantorum*, Jordan [*cf.* **28** 25, 26].

Gear (J.). **Complications in Tick-bite Fever.**—*S. Afr. med. J.* **13** pp. 35–36, 2 refs. Cape Town, 1939.

From the case records discussed, the author concludes that complications in cases of tick-bite fever occurring on the Witwatersrand are relatively frequent and may result in permanent disability or even death. It is well known that typhus and the related fevers are more severe in older persons, and in this series the complicated and fatal cases were nearly all in persons over 45 years of age. Another factor that may be responsible for the apparently greater severity of the Witwatersrand cases as compared with rural ones is a difference in vector, for whereas in the latter it is usually *Amblyomma hebraeum*, Koch [*cf. R.A.E.*, B **22** 17], on the Witwatersrand it is probably the dog tick, *Haemaphysalis leachi*, Aud., which has been proved to harbour the *Rickettsia* of tick-bite fever. It is possible that the virulence of the causal organism is enhanced by passage through a different tick. It is suggested that the risk of contracting the disease may be minimised by avoiding contact with tick-infested dogs.

Ordman (D.). **African Relapsing Fever in South Africa. An Outbreak of African Relapsing Fever in the Cape Province.**—*S. Afr. med. J.* **13** pp. 491–498, 5 figs., 10 refs. Cape Town, 1939.

In South Africa, cases of relapsing fever caused by *Spirochaeta* (*Borrelia*) *duttoni* and transmitted by *Ornithodorus moubata*, Murr., have occurred sporadically in Zululand, the Transvaal and Cape Province. Records of these cases are briefly reviewed and notes are given on the bionomics and morphology of the vector and its distribution in South Africa. An account is given of an outbreak among natives on a mine in the north-western area of Cape Province that lasted from the end of 1936 to April 1938 (when preventive and therapeutic measures were instituted) and comprised some 1,800 cases with 160 deaths. The natives were housed in poorly constructed barracks, and very large numbers of ticks were easily collected, chiefly from the crevices between the walls and the floors, but also from cracks in the brick walls and clay floors. All were identified as *O. moubata*. The control measures recommended included the laying of concrete floors with a smooth surface, the cementing and smoothing of the walls and the filling in and rounding off of the junction of walls and floor; the provision of bunks or beds, so that the natives could be forbidden to sleep on the floor; and the removal of bush for 50–100 yards around the compounds. While these permanent measures were

being carried out, all cracks in floors and walls were treated with the flame of a blow-lamp, thoroughly sprayed with a strong insecticide or drenched with kerosene. In an addendum, it is stated that there were no fresh cases and no deaths during the summer (October 1938–March 1939) after the preventive measures had been instituted, and the percentage of the native population not available for work on account of illness was only 1·7 as compared with 14·5 in the summer of 1937–38.

Murray (N. L.). **The Causal Organism of South African "Sandworm" Eruption. A preliminary Note.**—*Brit. med. J.* 1939 no. 4089 pp. 1026–1027, 1 fig., 2 refs. London, 1939.

The author briefly describes the symptoms of the skin affection known as "creeping eruption" or "sandworm" that occurs in man in South Africa, particularly in Natal and Zululand. Its aetiology has so far not been satisfactorily established, and it has been attributed to larvae of a species of *Gastrophilus* or *Hypoderma*, or alternatively to a larval dog-hookworm. In the author's investigations, the technique of which is described, an adult and two immature stages of a mite were recovered from the track of the eruption in one patient, and another adult and a number of eggs in another. The mite most closely resembling the observed forms is *Tetranychus molestissimus*, Weyenb., which occurs in Argentina and Uruguay on the lower surfaces of the leaves of *Xanthium macrocarpum* and causes severe dermatitis in man and animals.

Chorley (J. K.). **Report of the Division of Entomology for the Year ending 31st December, 1938.**—*Rhod. agric. J.* **36** no. 8 pp. 598–622 ; also as *Bull. Minist. Agric.* [*S. Rhodesia*] no. 1121, 25 pp. Salisbury, 1939.

The medical and veterinary section of this report is arranged on the same lines as in previous years [*cf. R.A.E.*, B **27** 20] and includes an account of the situations in 1938 in the various localities in Southern Rhodesia in which control measures against *Glossina morsitans*, Westw., are being carried out. Little ground has been recovered from tsetse fly during the year, as it will be two or three years before the results of extended operations become manifest. On the other hand no ground has been lost, and the ground recovered in previous years has been consolidated and further protected. Since the fly has been driven back from settled European areas and a greater degree of control has been exercised over the distribution of native-owned cattle, trypanosomiasis in them is rarely encountered. Apart from fairly heavy losses on the eastern border (Melsetter district) where about 60 cases occurred, about 20 cases occurred in the Gwaai-Shangani area and 5 in the Urungwe sub-district. In the Doma area, there are now some 1,800 head of native cattle in country formerly infested and no infection has yet been recorded. No cases of sleeping sickness occurred during the year. In the Melsetter District, 7 examples of *G. pallidipes*, Aust., and 4 of *G. brevipalpis*, Newst. [*cf.* **24** 201] were collected after a careful search ; it is not known whether these species breed in Rhodesia, but from the distribution of the catches, it is clear that the Inyamadzi River valley forms the main route along which flies enter the Colony at this part of the border. A visit to Portuguese East Africa confirmed the presence of *G. morsitans* in some numbers about 6 miles from the border, and occasional flies were taken still nearer to it.

HOYLE (W. L.). **Transmission of Poultry Parasites by Birds with special Reference to the "English" or House Sparrow and Chickens.**—*Trans. Kans. Acad. Sci.* **41** pp. 379-384, 6 refs. Topeka, Kans., 1938. [Recd. 1940.]

In view of references in the literature to the carriage by sparrows (*Passer domesticus*) of various ectoparasites of fowls, investigations were carried out in Kansas in 1936–37. In August 1936, a sparrow shot on the fence of a pen containing fowls free from lice was found to harbour one example of *Gallipeurus* (*Lipeurus*) *heterographus*, Nitzsch., and about three weeks later three of the fowls were found infested by the louse, which is presumed to have reached them from the sparrow through the dust bath. Of 567 sparrows collected in or about fowl pens, barns and wheat fields, 16 harboured the common fowl mite, *Dermanyssus gallinae*, DeG., and 3 of these were also infested by a species of *Liponyssus*. *G. heterographus* was found on one sparrow. *D. gallinae* was also observed in sparrows' nests constructed of fowl feathers.

In an experiment, batches of 10 examples of the common fowl louse, *Menopon gallinae*, L., were transferred from infested fowls to sparrows. One louse remained on a sparrow for as long as 9 days. When two heavily infested fowls were caged with five parasite-free sparrows, none of the latter became infested until about a month later, when the only survivor was found to harbour one half-grown louse and four newly-hatched individuals. Similar results were obtained in two further experiments. It is assumed that transfer was effected by direct contact or through the dust bath. When two infested sparrows were caged about 2 ft. away from two uninfested ones, three lice were observed on one of the latter after the death of the former. The maximum periods of survival of lice kept at about 94°F. were 72 hours in a vial containing a freshly plucked chicken feather, 27 hours in one containing dust, and 31 hours in an empty vial.

STUNKARD (H. W.). **The Development of *Moniezia expansa* in the Intermediate Host.**—*Parasitology* **30** no. 4 pp. 491–501, 1 pl., 22 refs. London, 1939.

The course of development of most of the larger groups of Cestodes has been traced, but repeated attempts made over a period of 50 years to discover the life-cycles of the members of the family ANOPLOCEPHALIDAE have until recently been unsuccessful. These Cestodes are very numerous and world-wide in distribution, and occur frequently in herbivorous domestic animals. Experiments showing that the onchospheres of *Cittotaenia*, the rabbit tapeworm, were not infective to rabbits, indicated that an intermediate host was necessary. Various minute terrestrial invertebrates, chiefly insects, were tested without success, using *Cittotaenia variabilis* from rabbits and *Moniezia expansa* from sheep, but in February 1936 onchospheres of both Cestodes were found in the body cavities of Tyroglyphid mites (probably a species of *Rhizoglyphus*) that had fed a few days previously on the eggs. Although the structure and habits of these mites did not indicate that they were a suitable intermediate host for either tapeworm, the fact that the onchospheres were liberated and migrated to the body cavity, even though they did not develop, suggested that a related mite was probably the host. Oribatid (Galumnine) mites were then tested, using chiefly eggs of *Moniezia*, which were more easily obtained than those of

Cittotaenia. During preliminary experiments onchospheres of both tapeworms were found in the body-cavities of these mites, and a lamb became infected after eating mites that had been kept for four months with eggs of *Moniezia*, but this is not regarded as conclusive, since accidental infection was not precluded. In the summer of 1937, however, a series of developmental stages of *Moniezia* from the onchosphere to the fully-formed cysticercoid was recovered from the body-cavities of the mites. The specific identity of the mites used is still undecided; they all belong to the genus *Galumna* as understood by Ewing, but include species that are referred to the genera *Galumna*, *Ceratozetes* and *Zetes* by A. P. Jacot [*cf.* also *R.A.E.*, B **27** 145].

When larvae of *Moniezia* emerge from the eggs, they are very active and almost immediately penetrate the wall of the digestive tract of the mite to reach the body cavity. The situation in which hatching actually occurs has not been determined, since onchospheres have been found only in the body cavity. The development of the larva within the mite is described. At the end of 15–16 weeks, the cysticercoid is fully formed. When gravid segments of *Moniezia* or *Cittotaenia* were left for several days in a Petri dish, the eggs that they originally contained were found in a layer some distance from the segments. Since the mites are not primarily coprophagous and live among the roots of grass, the distribution of the eggs would increase the probability of their ingestion and prevent a mass infection that might result in the death of the intermediate host. The distribution of the eggs would be further facilitated by rain, and eggs washed into the upper layers of moist soil would remain viable for a long time. Whether a heavy infestation results in the death of the mites is problematical. Four is the largest number of larvae found in one mite and, ordinarily, when more than one is present, they are correspondingly smaller than when there is only one, their development appears to be retarded and they mature at a smaller size. Not infrequently, one large and two or three smaller ones have been found together.

Cameron (A. E.). **Insect and other Pests of 1938.**—*Trans. Highl. agric. Soc. Scot.* 1939 repr. 40 pp., 16 figs., many refs. Edinburgh, 1939.

In view of the attention that has recently been attracted to *Ixodes ricinus*, L., as a pest of sheep in Scotland, the author has included in this survey, a brief account of its hosts, distribution, spread, bionomics, seasonal incidence and control [*cf.* *R.A.E.*, B **27** 242, etc.]. The control measures discussed include the burning of infested pasture and moorland, the drainage of and application of lime to marshy ground on which the tick is abundant, the starvation of the tick by the removal of stock for a year or more from infested pastures, and the dipping of live-stock.

Stewart (W. L.). **The Economic Importance of** *Ixodes ricinus*.—*Vet. J.* **95** no. 9 pp. 341–349. London, 1939.

Losses caused among sheep in Britain by *Ixodes ricinus*, L., are briefly discussed. Investigations into the high mortality among lambs in a tick-infested valley in Northumberland in 1937 showed that 50 out of 110 dead lambs examined had suffered and 30 had died from an infection that the author has termed tick pyaemia, which is characterised by multiple abscess formation [*cf.* *R.A.E.*, B **25** 219] on the skin and throughout the internal organs and joints, caused by a

staphylococcus that invades the blood and lymph streams, in all probability through wounds produced by the bites of ticks. Lambs are infected shortly after birth, and the disease is chronic, death only occurring when the functions of a vital organ are seriously impaired. Such pyaemia has not been observed on tick-free farms. Few lambs were found to have died from louping ill or tick-borne fever [*cf. loc. cit.*]. Redwater fever, caused by *Piroplasma* (*Babesia*) *bovis*, occurs in cattle throughout Britain and is spread by the larvae, nymphs and adults of *I. ricinus* ; in the north of England it is fairly common, but is not believed to produce heavy losses.

The reported spread of the tick is briefly discussed [*cf.* **27** 92]. Of the many measures that may theoretically be employed for tick destruction, only moor burning [*cf.* **27** 243] and sheep dipping are considered to be of much value under conditions of practical sheep-farming, and the value of burning is limited because moors in Britain are seldom dry enough to allow it to be really effective. Experiments were carried out with five dips containing derris alone or derris, carbolic acid and arsenic in various combinations, in which sheep were dipped a day or two before lambing and thereafter at intervals of three weeks throughout the tick season [*cf.* **26** 108]. Counts of ticks on dipped and control sheep each week for the 3 weeks following the first dipping showed that the derris dips that did not contain arsenic were effective in destroying the ticks, but were of little value as repellents ; it has been suggested to the author that the discrepancy between these results and those of other small-scale tests [*cf.* **27** 243] may be due to the difference in the length of time of immersion (which averages something less than 15 seconds when dipping is carried out by hill shepherds) since this appears to be more important with derris than with other dips. The most satisfactory dip was one containing arsenic and derris, which showed a marked repellent effect at the end of 2 weeks.

Lambs become infested soon after birth, but it is impracticable to dip them until they are about three weeks old, not, primarily, because of the risk of injuring them, but because earlier dipping seriously interferes with the shepherd's other duties at a time when he is busiest. Experiments were undertaken to test two methods of treatment that might be applied in this interval, when lambs may be severely bitten and many become infected with pyaemia. Dusting with a powdered preparation of derris root appeared to be the most satisfactory, since it is quickly and easily carried out, produces no ill-effects, and the dusted lambs remained remarkably free from ticks for more than a fortnight. An oily smear containing derris also checked infestation with ticks, and the treated lambs were more thrifty and, on an average, 10 lb. heavier than untreated ones.

SIMMONS (S. W.). **Some Histopathological Changes in the Skin of Cattle infected with Larvae of** ***Hypoderma lineatum*****.**—*J. Amer. vet. med. Ass.* **95** no. 750 pp. 283–288, 18 figs., 4 refs. Chicago, Ill., 1939.

The following is the author's summary : The principal histopathological changes resulting from invasion of the skin of cattle by *Hypoderma lineatum*, Vill., are described and illustrated. Injury is produced in the hide by extensive inflammation initiating a destructive necrosis, accumulation of extraneous débris in the skin, production of

larvaless abscesses at points distant from the cysts, the dying and walling-off of larvae prior to skin penetration, and unidirectional scar tissue fibres, which present a weaker pattern than the polydirectional fibres of normal tissue. Epidermal repair begins as soon as the skin is penetrated, and external healing may be accomplished in two weeks. Complete cicatrisation may require three or four weeks, but excessive débris may extend this period. Cellular infiltration is extensive and composed mainly of plasmocytes. Eosinophils and neutrophils are relatively scarce. Larvae may die after penetration of the skin and before dropping. These may remain in the cyst until absorbed, and thus greatly retard healing [*cf. R.A.E.*, B **27** 198]. Cysts containing larvae killed with insecticides are thus slower to heal than those from which the specimens have been extracted, or have dropped normally.

WOODBURY (E. N.) & BARNHART (C. S.). **Tests on Crawling Insects. Tentative Methods for evaluating liquid Household Insecticides against the German Cockroach and the Bedbug.**—*Soap* **15** no. 9 pp. 93, 95, 97, 99, 101, 103, 105, 107, 113, 9 figs., 5 refs. New York, N.Y., 1939.

The first year's work on the development of methods for testing oil-base insecticides against crawling insects was confined to devising methods of rearing and using *Blattella germanica*, L., as a test insect, and the results have already been noticed [*R.A.E.*, B **27** 17]. During the second year, similar investigations were carried out on the bed-bug [*Cimex lectularius*, L.], and various improvements were made in the methods of handling the cockroaches. In this final report, the methods evolved as a result of the two years' study are described. Little change is made in the methods already recommended for the cockroach, except that the small cardboard cylinders used for rearing are replaced by a large double cage. The egg-bearing females are placed in the inner cage, and the young cockroaches escape through the wire-screen bottom and take refuge in one of three coils of corrugated cardboard (codling moth bands) that rest on the solid floor of the outer cage and support the inner one. They are thus automatically segregated. The hatching cage should always contain about 1,000 egg-bearing females in order to provide about 1,000 young cockroaches a day. Every day, the inner cage is lifted off the coils and each coil is placed with food and water in a dated jar similar to a battery jar. After 12–14 days the cockroaches are tapped out of the bands, picked up with a blower aspirator (which is described) and placed in lots of 50 in test cages.

The testing equipment for bed-bugs is the same as for cockroaches, except that the test cage consists of a dish, to the bottom of which are cemented 25 small containers 15 mm. high, each of which is used to hold a single adult male bed-bug. Unless the bugs are segregated, they huddle together and those on the top of the pile protect the others from the settling mist. The rearing equipment should all be kept on a white-topped table surrounded by a metal moat containing oil, or water and oil, to prevent the escape of any bugs dropped during handling. The only type of cage required consists of the bottom of a large Petri dish, with a cover of white muslin stretched over and cemented to a 6-inch metal embroidery hoop, which is kept securely in place by means of two heavy rubber bands that cross at right-angles over the top. The bugs are fed once a week by keeping the cage

inverted, for not more than 15 minutes, against the clipped belly of a rabbit held firmly in a rack, which is described. The cage is covered with a black cloth, as the bugs feed more readily in the dark. More frequent feeding is unnecessary, since one full meal is sufficient for each instar. As there are 5 nymphal instars, bugs that fed at each opportunity reach the adult stage in 5 weeks. The eggs laid during a week are loosened from the mimeograph paper covering the bottom of the oviposition cages, and bugs and eggs are brushed into a 16-mesh sieve through which the latter fall into a clean dish ; eggs from several cages are combined. The bugs from the sieve are brushed into feeding cages, which have a circle of blotting paper on the bottom, and two days after feeding are returned to the oviposition cages. During these transfers dead bugs are removed and new adults added. All eggs that hatch do so within 6–7 days. As the nymphs increase in size they are distributed, to prevent overcrowding, among several cages, which contain pieces of blotting paper to act as shelters and to absorb the large quantities of liquid excreted after feeding, and once a week newly matured bugs are carefully removed from all dishes ; many males are set aside for use in tests and others placed with females in adult feeding cages for breeding purposes. The test males are fed at times that make them available two days after feeding.

The period of exposure of the bugs was adjusted so that the official test insecticide gave a mortality of 50 per cent. In the example given, the time of spraying was 30 seconds, the interval 20 seconds, and the time of exposure 70 seconds [*cf. loc. cit.*]. An average deposit of 0·73 mg. oil per sq. cm. was obtained with this timing. The bugs were kept in the same vials after treatment, so that residual effect, if any, could operate. All bugs not able to walk on a smooth glass surface were considered dead. At present, the use of cockroaches is the more practical procedure, but the simplification of the use of bed-bugs by employing nymphs instead of adult males for the tests may be possible. No significant difference was observed in the mean mortalities of male and female bed-bugs. The drop test method in which measured volumes of oil are forced from a capillary pipette directly upon individual bugs was used before large numbers of bugs became available. It is described because it is useful in determining the quantity of insecticide necessary to kill an individual bug. The median lethal dose of a refined kerosene was found to be about 0·076 cc. for male bed-bugs tested two days after feeding.

Sievers (A. F.) & Sullivan (W. N.). **Toxicity of *Tephrosia*. A Study of the Toxicity of *Tephrosia virginiana* Roots prepared by several Methods.**—*Soap* **15** no. 9 pp. 111, 113. New York, N.Y., 1939.

In connection with investigations on *Tephrosia virginiana* as a possible source of rotenone for insecticides, tests with acetone and chloroform extracts prepared in various ways were carried out on flies [*Musca domestica*, L.] by the Campbell-Sullivan turntable method [*cf. R.A.E.*, B **26** 246] to determine whether their toxicity is reduced by extraction on a hot plate, removal of the solvent by heating in determining the total extract, and similar procedures in which the extract is subjected to heat. A comparison of the results with those obtained with extracts made by simply shaking the root in acetone or chloroform showed that the differences were not significant.

Papers noticed by Title only.

Imperial Institute. **Quarterly Bibliographies on Insecticide Materials of Vegetable Origin, Nos. 4–8 (July 1938 to October 1939).**—*Bull. imp. Inst.* **36** no. 4 pp. 574–581; **37** nos. 1–4 pp. 65–72, 233–238, 405–412, 591–600. London, 1938–39. [*Cf. R.A.E.*, B **26** 224.]

Sicart (M.). **Note sur la présence en Tunisie de** *Aëdes* (*O.*) *pulchritarsis* (**Rondani 1872**) **variété** *stegomyia* [*stegomyina*, Stack. & Montsch.]. —*Arch. Inst. Pasteur Tunis* **28** no. 3 pp. 357–359, 4 refs. Tunis, 1939.

Brug (S. L.). **Efficiency of** *Filaria*-**vectors** [*F. malayi* and *F. bancrofti* in mosquitos in Netherlands Indies].—*Proc. 3rd Congr. trop. Med.* pp. 230–238, 7 figs. Amsterdam, 1939. [*Cf. R.A.E.*, B **25** 232; **26** 161.]

Lörincz (F.) & Mihályi (F.). **Beiträge zur Malariafrage in Ungarn** (*Anopheles maculipennis*-**Studien**). [Contributions to the Malaria Problem in Hungary (Studies on *A. maculipennis*, Mg.).] [*In Magyar.*]—*Állat. Közlem.* **35** no. 3–4 pp. 176–186, 4 figs., 6 refs. Budapest, 1938. (With a Summary in German.) [Recd. 1940.] [*Cf. R.A.E.*, B **26** 130.]

Dinulesco (G.) & Vasilesco (C.). **Etude anatomopathologique des tumeurs duodénales chez le cheval produites par les larves de** *Gastrophilus meridionalis* (**Pillers et Evans**).—*Arhiva vet.* 1937 no. 6 repr. 11 pp., 10 figs., 3 refs. Bucarest, 1938. [Recd. 1939.] [*Cf. R.A.E.*, B **20** 86.]

Candura (G. S.). **La mosca domestica. Vita, danni, lotta e osservazioni nella Venezia Tridentina.** [The House-fly (*Musca domestica*, L.). Its Biology, the Injury done by it, its Control and Observations made in the Trentino, Venetia.]—*Pubbl. prat. Fitopat. Igiene* no. 1, 16 pp., 15 figs. Bolzano, 1939.

Kröber (O.). **Katalog der palaearktischen Tabaniden nebst Bestimmungstabellen und Zusätzen zu einzelnen Arten sowie Neubeschreibungen.** [Catalogue of the Palaearctic Tabanids, together with Keys and Additions to individual Species and new Descriptions.]—*Acta Inst. zool. Univ. athen.* **2** no. 3–4 pp. 58–245. Athens, 1939.

Bequaert (J.). **Notes on Hippoboscidae. 13. A second Revision of the Hippoboscinae** [*Hippobosca*].—*Psyche* **46** no. 2–3 pp. 70–90. Cambridge, Mass., 1939. [*Cf. R.A.E.*, B **19** 114.]

Johnson (C. G.). **Taxonomic Characters, Variability, and Relative Growth in** *Cimex lectularius* **L. and** *C. columbarius* **Jenyns (Heteropt. Cimicidae).**—*Trans. R. ent. Soc. Lond.* **89** pt. 11 pp. 543–568, 1 pl., 8 figs., 15 refs. London, 1939.

Good (N. E.) & Prince (F. M.). **Two new Species of** *Opisocrostis* [*Ceratophyllus, sens. lat., oregonensis*, sp. n., and *washingtonensis*, sp. n., on *Citellus* spp. in the United States]. (**Siphonaptera**).—*Publ. Hlth Rep.* **54** no. 37 pp. 1687–1693, 4 figs. Washington, D.C., 1939.

Meyer (K. F.). **The Rôle of the infected and the infective Flea in the Spread of Sylvatic Plague.** [A review of the literature.]—*Vjschr. naturf. Ges. Zürich* **83** no. 3–4 Beibl. pp. 160–169, 30 refs. Zürich, 1938. [Recd. 1940.]

LENNOX (F. G.). **Studies of the Physiology and Toxicology of Blowflies. I. The Development of a Synthetic Medium for Aseptic Cultivation of Larvae of** *Lucilia cuprina.—Pamphl. Coun. Sci. industr. Res. Aust.* no. 90, 24 pp., 1 pl., 8 figs., 17 refs. Melbourne, 1939.

The following is substantially the author's summary : A technique is described for rearing larvae of *Lucilia cuprina*, Wied., in small, flat-walled bottles. Growth is recorded, without opening the cultures, by photographing the larvae at a standard magnification. The evolution of a basal medium for the aseptic cultivation of the larvae is also described [*cf. R.A.E.*, B **27** 196]. It contains only yeast and salt (sodium chloride), in addition to agar, which is added to give a suitable gel consistency. Although larvae reach full size on this medium, growth is more rapid on an enriched medium containing fresh egg-white in place of the agar. The pH limits for growth on synthetic media are wide, and vary from below four to beyond eight or ten, the exact upper limit depending on the composition of the medium.

WEHRLE (L. P.). **Observations on three Species of** *Triatoma* (**Hemiptera : Reduviidae**).—*Bull. Brooklyn ent. Soc.* **34** no. 3 pp. 145–154, 1 fig., 5 refs. Lancaster, Pa., 1939.

An account is given of observations in Arizona on the habits and seasonal prevalence of *Triatoma protracta*, Uhler, *Eutriatoma* (*T.*) *uhleri*, Neiva and *T. longipes*, Barber. The nymphs and adults of *E. uhleri* and the adults of *T. protracta* and *T. longipes* attack sleeping persons, and notes are given on a number of cases in which various unpleasant after-effects of their bites were observed. *T. protracta* and *E. uhleri* can be found throughout the year, either in the burrows of wood rats (*Neotoma albigula*), or in some other shelter where a source of blood is available. The habitat of *T. longipes* is not known. There is apparently a dispersal flight during May and June, when *E. uhleri* and *T. longipes* invade houses. Various means of controlling the bugs are suggested, the most effective being the removal of wood rats from the vicinity of houses. Records of the finding of *Trypanosoma cruzi* in Triatomids in the United States are very briefly reviewed [*cf. R.A.E.*, B **26** 144 ; **27** 132, etc.].

PACKCHANIAN (A.). **Natural Infection of** *Triatoma gerstaeckeri* **with** *Trypanosoma cruzi* **in Texas.**—*Publ. Hlth Rep.* **54** no. 34 pp. 1547–1554, 10 pls., 15 refs. Washington, D.C., 1939.

The Triatomids collected in the course of field studies carried out in Texas in October 1937 and September 1938 were *Triatoma gerstaeckeri*, Stål, *T. heidemanni*, Neiva, and *T. sanguisuga*, Lec. Large numbers of *T. gerstaeckeri* were found on a farm, adults being seen in the house and barn and nymphs in the nests of wood rats (*Neotoma micropus*). It was reported that the members of one family had killed 300 or more Triatomids every night for 6 weeks and that the bugs had been abundant every summer. Personal enquiry led to the discovery of more than 500 persons who had been bitten by these bugs. Fowls, cows and pigs are also often attacked. Of 100 live examples of *T. gerstaeckeri*, 92 were found to harbour trypanosomes. Trypanosomes

were readily demonstrable by microscopic examination in material from the intestines and in the excreta, but were never found in the saliva. From these examinations and from a detailed study of the trypanosomes in the blood of laboratory animals infected by injection of faecal material from infected bugs, it is concluded that they are *Trypanosoma cruzi*.

PIFANO (F.). **Anotaciones acerca del** *Psammolestes arthuri* ; **Pinto 1926 (Hemíptera, heteróptera, triatomidae) ; reduvideo hematófago encontrado en nidos de cucarachero de monte (probablemente Dendrocolaptidae) en un sector de los Valles del Yaracuy. Su importancia como posible vector en la naturaleza del** *Schizotrypanum cruzi*, **Chagas, 1909.** [Notes on *Psammolestes arthuri*, a blood-sucking Reduviid found in Nests of a " cucarachero de monte " (probably a Dendrocolaptid) in a Sector of the Valleys of the Yaracuy. Its importance as a possible Vector in the Biology of *Trypanosoma cruzi*.]—*Gac. méd. Caracas* **45** no. 16 pp. 241–245, 5 figs. Caracas, 1938. (Abstr. in *Trop. Dis. Bull.* **36** no. 9 pp. 753–754, 1 fig. London, 1939.)

A detailed description is given of *Psammolestes* (*Eutriatoma*) *arthuri*, Pinto [*cf. R.A.E.*, B **15** 47], taken in the nests of a bird in Venezuela. This Triatomid, which has not been recorded from other countries, was not found naturally infected with *Trypanosoma* (*Schizotrypanum*) *cruzi*, but since it readily became infected when given infective feeds in the laboratory, it may be concerned in the transmission of Chagas' disease.

DE CASTRO FERREIRA (L.) & DEANE (L.). **Transmissão experimental do** " *Schizotrypanum cruzi* " **(Chagas, 1909) pelo** " *Clerada apicicornis* " **Signoret, 1863. Nota prévia.** [Experimental Transmission of *Trypanosoma cruzi* by *Clerada apicicornis*.]—*Brazil-med.* **53** no. 6 p. 239. Rio de Janeiro, 1939. (Abstr. in *Trop. Dis. Bull.* **36** no. 9 p. 754. London, 1939.)

An example of the Lygaeid, *Clerada apicicornis*, Sign., the faeces of which were found to be free from flagellates, was allowed to feed on a mouse experimentally infected with *Trypanosoma* (*Schizotrypanum*) *cruzi*. Examination of the faeces of the bug revealed crithidia and metacyclic forms 14 days later. A suspension of these was injected into the peritoneum of a rat and characteristic trypanosomes were found in its blood after 13 days. *C. apicicornis* is widely distributed in the delta of the Amazon, and in this area many animals are found naturally infected with *T. cruzi*.

DEANE (L.) & JANSEN (G.). **Encontro de** *Schizotrypanum cruzi* **(Chagas, 1909) em marsupiaes da especie** *Marmosa cinerea* **Demarest.** [Finding of *Trypanosoma cruzi* in Marsupials of the Species *Marmosa cinerea*.]—*Brazil-med.* **53** no. 7 pp. 265–266, 4 figs. Rio de Janeiro, 1939. (Abstr. in *Trop. Dis. Bull* **36** no. 9 p. 754. London, 1939.)

Examination of 40 examples of the opossum, *Marmosa cinerea*, in the State of Pará, Brazil, revealed *Trypanosoma* (*Schizotrypanum*) *cruzi*

in smears of spleen, liver, heart, lungs and bone marrow, and laboratory animals into which blood was inoculated all became infected. Examples of *Triatoma brasiliensis*, Neiva, were allowed to feed on one of the infected mice, and crithidial and metacyclic forms were found in their faeces 12–18 days later. An example of *Clerada apicicornis*, Sign., showed the same 10 days after a feed.

JORDAN (K.). **On five new Siphonaptera from the Republic of Argentina.**—*Novit. zool.* **41** pp. 292–303, 10 figs. London, 1939.

In a note appended to the descriptions of five new species of fleas, the author states that *Hectopsylla mazzai*, Costa Lima [*R.A.E.*, B **24** 39] is a synonym of *H. broscus*, Jord. & Roths., and *Maxilliopsylla lilloi*, Schreitt & Shann. [**24** 168] of *Rhynchopsyllus pulex*, Haller.

SEARLS (E. M.) & SNYDER (F. M.). **A Study of the Relation of Vitamin A to Louse Resistance in Rats.**—*J. Parasit.* **25** no. 5 pp. 425-430, 4 refs. Lancaster, Pa., 1939.

The experiments described indicate that rats maintained on a diet deficient in vitamin A lose their resistance to infestation with *Polyplax spinulosa*, Burm., since they readily became heavily infested when lice were placed upon them. On the other hand, rats that had received an abundance of this vitamin failed to become infested when similarly exposed, and on many of the infested rats the numbers of lice were reduced to few or none after the deficiency of vitamin A had been corrected.

CANTRELL (W.). **Relation of Size to Sex in Pupae of** *Aëdes aegypti* **(Linn.),** *A. triseriatus* **(Say) and** *A. vexans* **Meigen.**—*J. Parasit.* **25** no. 5 pp. 448–449. Lancaster, Pa., 1939.

In the course of rearing *Aëdes aegypti*, L., it was observed that the pupae were of two distinct sizes and that the larger ones gave rise to females and the smaller ones to males. To check the difference in size, measurements were made of the greatest length of the cephalothorax in two lots of pupae reared under normal conditions and in one lot obtained from larvae purposely overcrowded and fed sparingly. In the first two lots, the differences in size were confirmed, and the ranges in the size of the sexes did not overlap. In the third lot, the size of the female pupa was reduced to below that of the normal male, the female pupae were reduced proportionately more than the male pupae, and, although a difference between the sexes remained, the ranges in size overlapped. Thus size can be used to separate the sexes in the pupal stage only when the pupae have developed under favourable conditions and under the same conditions of crowding. Measurements of the pupae of two other species showed almost as great differences in size between the sexes in *A. triseriatus*, Say, as in *A. aegypti*, except that the size ranges overlapped somewhat, whereas among pupae of *A. vexans*, Mg., there was practically no difference in size and the ranges were almost identical.

Glasgow (R. D.). **Mosquitoes and Wild Life as interrelated Problems in Human Ecology.**—*Bull. N.Y. St. Mus.* no. 316 pp. 7–20. Albany, N.Y., 1938. [Recd. 1940.]

Taylor (N.). **A preliminary Report on the Salt Marsh Vegetation of Long Island, New York.**—*T.c.* pp. 21–84, 1 map, 19 figs.

Richards, jr. (A. G.). **Mosquitoes and Mosquito Control on Long Island, New York, with particular Reference to the Salt Marsh Problem.**—*T.c.* pp. 85–180, 23 figs., 8 pp. refs.

In the first of these three papers, the author briefly reviews the expansion since 1930 of the organisations for the control of mosquitos in the State of New York, summarises the breeding habits of mosquitos of the genera *Culex*, *Anopheles* and *Aëdes*, and outlines the principles of the control of breeding with special reference to the salt marshes of Long Island. The development of mosquito control has proceeded independently of the movement for the conservation of wild life, and co-ordination is necessary if natural habitats are not to be destroyed.

In the second paper, the character and distribution of the salt marshes on Long Island are described, and their vegetation and the factors limiting it are discussed. Investigations have shown that ditching, which is one of the chief methods of preventing mosquito breeding and which results in the alternate flooding and draining twice daily of large areas of marsh, in accordance with the tides, does not affect the character or level of the water under the marsh and hence results in no fundamental change in vegetation.

In the third paper, the growth of the movement for the control of mosquitos in the salt marshes is summarised, and the methods in use are described. They comprise ditching, cleaning creeks and streams, filling and impounding, inspection of cesspools and sewage filter beds, the examination of pastures for hoofprints and broken ditches, oiling and spraying. The history of malaria on Long Island is summarised. Of the Anophelines that are present, the most important vector is *Anopheles quadrimaculatus*, Say, but this species is now very uncommon, owing to the control methods employed. The breeding places of mosquitos on Long Island are described and discussed. The regulating factor in the low-lying areas is the salinity of the water, which varies considerably from locality to locality. A list is given of the mosquitos recorded from Long Island and New York City, and factors affecting the migration of mosquitos are reviewed, mostly from the literature. The chief are weather and the density of the mosquito population at the breeding ground.

Riley (W. A.) & Chalgren (W.). **The Pest Mosquito Problem in the Minneapolis - St. Paul Metropolitan Area.**—*J. econ. Ent.* **32** no. 4 pp. 553–557, 3 refs. Menasha, Wis., 1939.

An account is given of two mosquito surveys made by collection of adults in the vicinity of Lake Minnetonka in the metropolitan area of Minneapolis and St. Paul, from 21st June to 15th October 1937 and from 1st April until the end of the season in 1938. The mosquitos were caught in traps and by hand, and the relative prevalence of the different species as indicated by the two methods of catching is discussed. The surveys confirmed earlier conclusions that the species primarily responsible for annoying man is *Aëdes vexans*, Mg., which constituted over 98 per cent. of the mosquitos trapped and identified

in the two seasons. Seasonal conditions affecting the abundance of mosquitos are discussed. For some 10 years the rainfall in Minnesota had been subnormal and the numbers of pest mosquitos so reduced that they attracted little attention. Conditions were more normal in 1937 and mosquitos became more abundant, while heavy rainfall in 1938 led to an excessive increase in their numbers. In view of the vast area involved and the innumerable breeding places created by heavy rainfall, control by means of larvicides is considered impracticable, and the measures recommended are filling and draining and the clearing of the shore lines of permanent lakes to allow the access of fish and other natural enemies of mosquito larvae.

SEVERIN (H. C.). **The Brown-banded Cockroach in South Dakota.**—*J. econ. Ent.* **32** no. 4 p. 595. Menasha, Wis., 1939.

Supella supellectilium, Serv. [*cf. R.A.E.*, B **27** 55, etc.] was first recorded in South Dakota in December 1936, when it was found infesting an apartment building in Sioux Falls. It has since been found in several dwellings in the town. It is thought that it may have been introduced in household goods from Florida.

STONE (W. S.) & REYNOLDS (F. H. K.). **Hibernation of Anopheline Eggs in the Tropics.**—*Science* (N.S.) **90** no. 2338 pp. 371–372. New York, N.Y., 1939.

Although a small amount of Anopheline breeding continues throughout the dry season in Panama, and a few adults probably survive until the rains, the sudden increase in the population of Anopheline larvae and adults 7–10 days after the beginning of the rainy season is considered to be too great to be accounted for in these ways. Observations were therefore carried out in 1938–39 to determine whether the local Anophelines are able to survive the dry season in the egg stage. Eggs of *Anopheles albimanus*, Wied., taken in December 1938 appeared somewhat larger than those observed in summer, and many of them required 7–14 days to hatch, instead of 24–48 hours, while others, though apparently viable, had not hatched after 14 days. On 10th April 1939, superficial, slightly moist earth from a seepage area in the Canal Zone on which there had been no water for at least a month was covered with tap-water containing hay infusion and protected by a screen. Two days later three larvae of *A. punctimacula*, D. & K., and one of *A. albimanus* were observed in the pan, in addition to larvae of *Culex*, *Aëdes* and *Psorophora*. When further samples of earth were collected on 17th and 26th April and 1st May and treated similarly, larvae of *Anopheles albimanus*, *A. punctimacula*, and *A. tarsimaculatus*, Goeldi, were obtained.

CORRADETTI (A.). **L'anofelismo nella regione Uollo Jeggiu.**—*Riv. Parassit.* **3** no. 3 pp. 207–219, 1 map, 3 graphs. Rome, 1939. (With Summaries in French, English and German.)

A list is given of the species of *Anopheles* observed by the author in the Uollo Jeggiu region of Amhara, Abyssinia, from July 1937 to March 1939. In addition to those already recorded from this region [*R.A.E.*, B **26** 183; **27** 117, 175; **28** 22], they include *A. marshalli*,

Theo., two larvae of which were observed in March 1939, and *A. pharoensis*, Theo.

Tables are given showing the months in which larvae of the various species were observed in the region as a whole and in a number of localities in it. Larvae of *A. gambiae*, Giles, occurred throughout the year. The greatest number of species was observed during the dry season, from February to June. During this period, at altitudes below about 3,300 ft., *A. gambiae* predominated in all the breeding places, which are almost exclusively permanent streams. Between 3,300 and 6,000 ft., *A. cinereus*, Theo., *A. coustani*, Lav., *A. demeilloni*, Evans, and *A. pretoriensis*, Theo., were the prevailing species, and *A. christyi*, Newst. & Cart., *A. gambiae*, *A. pharoensis*, *A. rhodesiensis* var. *dthalisimilis*, Corradetti, *A. squamosus*, Theo., and *A. macmahoni*, Evans, were less common. *A. dthali*, Patt., was found in only one breeding place. Above 6,000 ft. most breeding places contained only *A. cinereus*, but larvae of *A. garnhami* occurred in some districts. *A. christyi*, *A. coustani*, *A. demeilloni* and *A. squamosus* were found in small numbers up to about 6,600 ft.

The heavy rains from July to September destroy the dry season breeding places, and form pools of water, apparently without vegetation, which results in a rapid and wide variation in the larval population. Up to 6,000 ft., *A. gambiae* predominated, but it occurred at this altitude only at the end of the rainy season. *A. christyi*, although less abundant than *A. gambiae*, also showed a tendency to increase, especially between 6,000 and 6,600 ft. Larvae of *A. pretoriensis*, *A. coustani* and *A. pharoensis* were found occasionally. Above 6,600 ft. most breeding places disappear temporarily owing to the violence of the rains.

CORRADETTI (A.). **Una nuova specie di** *Anopheles* **rinvenuta in Dancalia :** *Anopheles* (*Neocellia*) *dancalicus* **n. sp. Nota preliminare.** —*Riv. Parassit.* **3** no. 3 pp. 277–278. Rome, 1939. (With Summaries in French, English and German.)

Descriptions are given of the adults, larva and pupa of *Anopheles* (*Neocellia*) *dancalicus*, sp .n., which was observed in January 1939 in the valley of the Dobi in southern Dancalia [Danakil], Abyssinia. Larvae were taken in brackish water about 800 ft. above sea level.

SHUTE (P. G.) & UNGUREANU (E.). **Preliminary Report on the Longevity of the Races of** *Anopheles maculipennis*.—*L.o.N. Hlth Org. Malar. Comm.* C.H./Malaria/273, 11 pp. multigraph. Geneva, 1939.

When transporting adults of *Anopheles maculipennis*, Mg., by train between England and Rumania, the author found that the rate of mortality was very low among examples of race *atroparvus*, van Thiel, provided that blood meals were available, whereas it was extremely high among examples of races *maculipennis* (*typicus*) and *messeae*, Flni. Moreover, in an English laboratory where *atroparvus* is used in malaria therapy, 80 per cent. of the mosquitos frequently survive long enough for sporozoites to appear in the salivary glands, whereas at a malaria-therapy centre in Rumania, where the work is done with *maculipennis* and *messeae*, it has been difficult to keep even 10 per cent. alive for two weeks at any season of the year. So far as could be

ascertained, the conditions obtaining in the two laboratories were similar and the techniques used were identical. These observations led to an investigation on the longevity of the races of *A. maculipennis*, and an account is given of seven experiments, five of which were carried out in Rumania in June–September and two in England in July–August. The technique is described, and the temperature and humidity conditions obtaining in each experiment are given. The mosquitos were allowed ample opportunities to feed on man or animals. At the beginning of each experiment, a second batch of females of *atroparvus* was fed on a person infected with *Plasmodium vivax*, and the length of time taken for sporozoites to appear in the salivary glands was noted. It was assumed that malaria parasites would develop at the same rate in all the races, and the percentages of survival were, therefore, estimated at the end of this period. The average percentages of *atroparvus*, *maculipennis* and *messeae* that survived long enough for the malaria parasite to have completed its development in them were 87, 55 and 32, respectively. The survival rates in Rumania were highest in all three races in August, the hottest season of the year. Variation in the rates was greatest in *messeae*, of which 65 per cent. survived in August and only 4 per cent. in June. Females of *messeae* and *maculipennis* were not fertilised, whereas eggs were deposited daily by females of *atroparvus* ; this would appear to indicate that ovarian development and oviposition did not greatly increase the rate of mortality in *atroparvus* [*cf. R.A.E.*, B **18** 33]. Since only 4 per cent. of *messeae* survived in June, it is concluded that it cannot be of any importance in the transmission of malaria in Rumania at this time of the year. In one instance, 85 per cent. of *maculipennis* survived in August, and this may indicate that it is a significant vector at this season. Race *atroparvus* usually feeds readily either on man or animals; *maculipennis* feeds readily on animals, but is often reluctant to feed on man ; and *messeae* is reluctant to feed on man, even when partly starved. In a few experiments carried out to determine the relative efficiency of the different races as vectors of malaria, the percentages infected with oöcysts were always higher in *atroparvus* than in *maculipennis* or *messeae* and the numbers of oöcysts per mosquito were greater.

Barrowman (B.). **Replanting and Malaria.**—*J. Malaya Br. Brit. med. Ass.* **3** no. 2 pp. 170–174. Singapore, 1939.

Since replanting of rubber reproduces many of the conditions that were responsible for tremendous epidemics of malaria when rubber was first planted in Malaya, the author discusses methods of avoiding similar results at the present time. If the flight range of the vector is extended by the creation through clearing of an easier though longer route to the source of blood, the control measures may be carried out for a distance greater than half a mile, or repellent measures, such as oiling, may be intensified within the usual control area, for it has been observed that these extended flights take place more often, if not exclusively, into areas where measures that are not actively repellent, such as subsoil drainage, are employed. Another effect of clearing may be to increase the contact of *Anopheles maculatus*, Theo., with man, since this species selects for preference suitable resting places outside habitations, but is forced to seek shelter within the houses if all attractive shade is cleared away. Moreover, having taken

a blood-meal, the mosquito may prefer a less attractive breeding place that is nearer than a more normal type further away. Thus it is not safe to say that certain water collections will not be used for breeding because they have not been selected in the past.

In these cases, it is the normal habits of the mosquito that are affected and the problems arising can be dealt with only by a malariologist. Planters can, however, deal with the practices that tend to increase opportunities for mosquito breeding, and although some modifications of such practices may be necessary, these have not been found to be incompatible with agricultural requirements. Excavations, such as silt pits, that are designed to prevent the top soil on a hillside from being washed away by rain-water rushing straight down over the surface allow displaced soil to settle down and the water to soak into the soil. If, however, the water is not absorbed in a week, stops should be opened on the inner side of the pit and the water allowed to flow slowly down the hill in a spiral direction until it reaches a part where it can be absorbed. Moreover, if the soil of the hillside contains much clay, digging such pits may expose the clay and allow the seepage of water in which *A. maculatus* may breed. Such seepages may be dealt with by fascine packing and facing or by earth filling. Other practices that tend to increase the breeding of vectors are the removal of shade and consequent exposure of existing water collections to sunlight in areas where *A. maculatus* is the vector, blocking streams and drains by felling trees across them, and delaying for more than ten days the filling of holes caused by the removal of tree roots. In areas where *A. umbrosus*, Theo., is the vector, it may be thought that the removal of shade by the felling of the rubber trees will prevent mosquito breeding, but it is pointed out that the ragged edges of a root hole provide shaded pockets ample for breeding purposes. Holes prepared for replanting should be filled with cut vegetation. When the trees, which consume subsoil water, are removed, the water table rises, and more and greater seepages and surface collections of water are produced. To counteract this, the drainage of the area may have to be modified by deepening existing drains or increasing their number in *umbrosus* areas, or by setting hill-foot drains higher up the slope in *maculatus* areas. On the other hand, replanting may offer an opportunity for altering a drainage system to make it more effective.

Agricultural " covers " are often grown at the time of replanting, but are undesirable from the point of view of malaria control. The shade of most covers is sufficient to attract *A. umbrosus* and not sufficient to repel *A. maculatus*, so that they should not be planted near water surfaces. Bush cover is in all cases preferable to a creeping cover. Moreover, one of the purposes of such covers is to open up dense impervious clay subsoils, but at a certain stage in this process the clay develops a high capillarity and capillary seepages forming under the shade of the covers provide attractive breeding places for *A. umbrosus*. Thus land under cover in *umbrosus* areas requires more and deeper drains than are necessary when it is clean-weeded, and as these drains must be kept free from vegetation, whether of encroaching cover or a water grass that readily invades water collections in covered areas, the weeding costs are higher. In *maculatus* areas under cover, temporary or occasional seepage areas must be treated as permanent ; being under cover, they cannot be detected for temporary or occasional treatment. Thus, some of the advantages of covers are offset by the increased cost of malaria control measures.

BARROWMAN (B.). **An Expedient in antimalarial subsoil Drainage.**—*J. Malaya Br. Brit. med. Ass.* **3** no. 2 pp. 175–176. Singapore, 1939.

When subsoil drains are laid among trees in Malaya, they frequently become blocked by tree roots, so that the trees must be removed or the drains abandoned. During the dry weather, the tree roots are attracted to the only available source of water, which is inside the pipe-line; they enter the pipe through the open joints, and eventually block them. The stoppage is not noticeable until rain falls and the drains fail to function. It is often claimed that pipes laid at a depth of 5 ft. will not be choked, but this is not so, and the author has observed pipes laid at a greater depth to be blocked by the roots of uncut lallang during periods of drought. Moreover, the structure of the soil frequently does not allow of pipes being laid so deep, and it is often undesirable or even impossible to remove all trees for a sufficient distance from drains, since the roots of a tree will spread for a distance equal to 1½ times its height. Under these conditions, the author has found that two pipe lines laid one above the other are effective. In dry weather, when the soil is dry and the water table has been lowered, the only water available is spring water running through the lower pipe line and the roots, therefore, enter this line only. When the rains come and the trees obtain all the water they need from the soil, the upper pipe line remains patent to function as a drain. In one instance where a pipe line had previously become choked regularly every year, the double line is still functioning, without repair, after six years. The cost of laying the double line is little more than that of laying a single one.

HU (S. M. K.). **Studies on the Susceptibility of Shanghai Mosquitoes to experimental Infection with *Wuchereria bancrofti* Cobbold. VIII. *Culex bitaeniorhynchus* Giles.**—*Peking nat. Hist. Bull.* **14** pt. 1 pp. 15–22, 7 refs. Peiping, 1939.

During 1934–35 and 1937, experiments similar to those already noticed [*R.A.E.*, B **28** 42, etc.] were undertaken in Shanghai to determine the susceptibility to infection with *Filaria* (*Wuchereria*) *bancrofti* of females of *Culex bitaeniorhynchus*, Giles, reared from larvae collected locally and dissected after allowing time (13–24 days) for the development of filarial larvae to the infective stage. Only 33 out of 90 mosquitos harboured filarial larvae. Of these, 23 contained dead first-stage larvae only, 1 dead second-stage larvae only, 8 living immature larvae that did not appear likely to be able to complete their development, and only 1 infective larvae, of which 3 were in the abdomen and 1 in the thorax. That the retardation of development was not attributable to seasonal influences was indicated by the finding of infective larvae in some of the batches of *Culex pipiens* var. *pallens*, Coq., and *C. vagans*, Wied., that had taken their infecting feed at the same time [*cf.* **27** 124]. From these experiments, it appears unlikely that *C. bitaeniorhynchus* is of importance as a vector of filariasis in the Shanghai region.

OSWALD (B.). **On Yugoslavian (Balkan) Ticks (Ixodoidea).**—*Parasitology* **31** no. 3 pp. 271–280, 1 map, 1 diagr., 18 refs. London, 1939.

A list is given of 23 species and varieties of ticks that have been recorded from Jugoslavia [*cf. R.A.E.*, B **26** 91, etc.], with notes on the

morphology of some of them and a table showing their hosts. One new subspecies and one new variety are described. The distribution and seasonal prevalence of the commoner species found on domestic animals and the relation of certain species to tick paralysis [*cf.* **27** 149, etc.] are briefly discussed.

OSWALD (B.). **O do sada poznatim metodama za uništavanje krpelja (Ixodoidea).** [The hitherto known Methods of Tick Eradication.] [*In Serbian.*]—*Jugoslov. vet. Glasn.* 1939 no. 11 repr. 13 pp., 1 fig., 42 refs. Belgrade, 1939. (With a Summary in English.)

Measures that have been recommended in the literature for the control of ticks that attack domestic animals are reviewed, and their applicability to conditions in Jugoslavia is discussed. Special attention is devoted to dipping, including the technique of the procedure and the preparation of the dips. The construction of a concrete dipping tank for cattle is described, and a programme is outlined for the organisation of a campaign against ticks in Jugoslavia.

CHUMAKOV (M. P.) & GLADKIKH (S.). **On the Rôle of Ixodidae in communicating Spring and Summer Encephalitis.**—*Bull. Biol. Méd. exp. URSS* **7** no. 2–3 pp. 221–223. Moscow, 1939.

The authors briefly refer to work in the Russian Union on the transmission by ticks of the virus of spring-summer encephalitis [*cf. R.A.E.*, B **27** 69, 239, 240] and describe laboratory investigations carried out in Moscow in 1937. No infection could be demonstrated in about 600 male and female ticks taken in nature, of which most belonged to the genus *Ixodes* and a few to *Haemaphysalis* and *Dermacentor*, either by allowing them to feed on healthy mice for 3–4 or 24 hours, or by injecting filtered or non-filtered suspensions of them into the brain, hypodermally or into the abdominal cavity of mice. Later, the disease was transmitted to 2 of 3 healthy mice by injecting into their brains a suspension of an adult of *Ixodes* that had been allowed to feed for 14 hours on an infected mouse and had then been kept for 6 days at about 20°C. [68°F.], and 7 adults of *Ixodes* were similarly shown to have preserved the virus for 8 days. The preserved and desiccated bodies of ticks fed on infected mice did not contain the virus 3 months after the infecting feed. When two females of *Ixodes* were allowed to feed for 4 hours on an infected boy and were transferred 3 days later to a healthy mouse and kept on it for 24 hours, the mouse died on the 16th day. It showed no symptoms of the disease, but a strain of the virus was subsequently isolated from its brain.

BONÉ (G.). **Contribution à l'étude de la transmission de la fièvre récurrente tropicale (premier mémoire).**—*Ann. Soc. belge Méd. trop.* **19** no. 3 pp. 279–334, 44 refs. Brussels, 1939.

This paper on the mode of transmission of *Spirochaeta duttoni* by *Ornithodorus moubata*, Murr., is divided into five sections, and the information in four of them has already been noticed from shorter accounts [*R.A.E.*, B **27** 111, 141]. In the other section are given the results of experiments made to determine whether " Leishman granules" found in the cells of the Malpighian tubes of ticks and thought by various authors to be stages in the life-cycle of the spirochaete [*cf.* **1** 33 ; **25** 24, etc.] are, in fact, connected with the infection. Examination of the Malpighian tubes dissected from ticks fed 1–15 days

previously either on infected or healthy mice revealed the presence of numerous small granulations in the protoplasm of most of the cells of these tubes. They were seen in all sections at whatever interval after the infecting meal the fixation had been carried out (1, 2, 3, 5, 10 or 15 days) and whether the tubes were taken from infected or uninfected ticks, so that they could have had no connection with the development of the spirochaete.

Brumpt (E.), Mazzotti (L.) & Brumpt (L. C.). **Etude épidémiologique de la fièvre récurrente endémique des hauts plateaux mexicains.**—*Ann. Parasit. hum. comp.* **17** no. 4 pp. 275–286, 2 pls., 38 refs. Paris, 1939.

Brumpt (E.) & Brumpt (L. C.). **Identité du spirochète des fièvres récurrentes à tiques des plateaux mexicains et du** *Spirochaeta turicatae*, **agent de la fièvre récurrente sporadique des Etats-Unis.**—*T.c.* pp. 287–298, 9 refs.

It is stated in the first paper that relapsing fever was not definitely diagnosed in Mexico until 1936, when H. Pilz & H. Mooser found 3 cases in the town of Aguascalientes at an altitude of about 6,000 ft. [but *cf. R.A.E.*, B **18** 271]. They succeeded in infecting rats by means of suspensions of examples of *Ornithodorus turicata*, Dugès, collected in the house of an infected person and kept without food for 17 days, but not by means of suspensions of lice [*Pediculus humanus*, L.] taken on an infected person and fed on one of themselves for the following 10 days. Further cases were later found in the same town, chiefly in December 1936. In 1938 a study was made of batches of ticks from various places on the central Mexican plateau. *O. megnini*, Dugès, predominated in these batches, but since this species is a one-host tick and cannot feed in the adult stage [*cf.* **25** 122], the authors consider that it cannot be concerned in the transmission of relapsing fever. Suspensions of examples of *O. turicata* inoculated into rats and mice in Mexico gave negative results, but 7 out of 15 lots of the same tick collected in several localities, including Aguascalientes and Irapuato, proved to be infected when suspensions of them were inoculated into rats in Paris. Batches of the other three species of *Ornithodorus* found in Mexico, namely, *O. nicollei*, Mooser, *O. talaje*, Guér., and *O. coriaceus*, Koch, collected from various localities in different States proved to be uninfected [*cf.* **21** 244]. The authors were prevented by lack of time from searching the burrows of the various animals that might act as reservoirs of the disease on the high plateaux, but an example of *O. talaje* was taken in the nest of an armadillo in the hot part of the country, and the numerous uninfected examples of *O. nicollei* mentioned above were taken in the burrows of *Neotoma* (*Hodomys*) *alleni*. In the United States, *O. turicata* is found in the burrows and caves inhabited by the wild animals that act as reservoirs of the relapsing fever it transmits [*cf.* **22** 181 ; **25** 126], but in Mexico it is abundant in dwellings and particularly in outhouses such as pig-sties and, more rarely, cow-sheds. It may remain without feeding for several years in places where conditions are favourable. Its natural enemies include hens, which wander everywhere in rural dwellings, and ants.

In the second paper, an account is given of investigations to determine the identity of the spirochaete causing relapsing fever in

Mexico. Morphologically it resembles those causing tick- and louse-borne relapsing fevers in other parts of the world. Attempts were therefore made to identify it by means of its biological characteristics. Man was infected in 7 cases out of 7 when 10 examples of *Ornithodorus turicata* were left for a quarter of an hour on the forearm. The symptoms of the disease in man are described, and the use of this induced relapsing fever as a therapeutic measure is discussed. Notes are given on the development of the disease in various laboratory animals, its longevity in the brains of rats, and the results of cross-immunity experiments with homologous and heterologous strains from Aguascalientes and Irapuato and with a strain of *Spirochaeta turicatae* from Texas. The Mexican spirochaete was not transmitted by the bites of *O. coriaceus*, *O. nicollei*, *O. talaje* or *O. venezuelensis*, Brumpt. All these observations indicate that the Mexican spirochaete is *S. turicatae*, the causal agent of relapsing fever in the United States, and not *S. venezuelensis*, which causes the disease in tropical America, and is transmitted by *O. talaje* and *O. venezuelensis*. Moreover, since the spirochaete is not transmissible by *O. coriaceus*, *O. nicollei* and *O. talaje*, the species that inhabit the warm parts of Mexico, the disease it causes is likely to remain confined to the high plateaux where *O. turicata* is abundant.

BRUMPT (E.), MAZZOTTI (L.) & BRUMPT (L. C.). **Enquêtes épidémiologiques sur la maladie de C. Chagas au Mexique. Réduvidés vecteurs. Animaux réservoirs de virus. Cas humains.**—*Ann. Parasit. hum. comp.* **17** no. 4 pp. 299–312, 5 pls., 23 refs. Paris, 1939.

DENECKE (K.) & VON HALLER (E.). **Recherches expérimentales sur le mode de transmission et le cours de l'infection par** *Trypanosoma cruzi* **chez les souris.**—*T.c.* pp. 313–319, 7 refs.

BRUMPT (E.). **Mode de transmission de la maladie de C. Chagas.**—*T.c.* pp. 320–331, 3 figs., 45 refs.

In the first paper, the authors briefly review investigations undertaken since 1932 in various parts of Mexico, where Chagas' disease, which is caused by *Trypanosoma cruzi*, did not appear to be present. The Triatomids recorded from Mexico are *Eutriatoma* (*Triatoma*) *maxima*, Uhler, E. (*T.*) *sonoriana*, Del Ponte, *Triatoma gerstaeckeri*, Stål, *T. mexicana*, H.-S., *T. protracta*, Uhler, *T. rubida*, Uhler, *T. barberi*, Usinger, *T. dimidiata*, Latr., *T. maculipennis*, Stål, *T. pallidipennis*, Stål, *T. phyllosoma*, Burm., and *Rhodnius prolixus*, Stål. Of these the authors encountered the last 7 (which are the most common species and are found in the hot parts of the country), but they consider *T. maculipennis* to be a form of *T. dimidiata* and do not mention it in a table giving details of the degree to which the bugs they collected in various localities were naturally infected with *T. cruzi*. Natural infection was demonstrated in each of the species, and in several cases more than 50 per cent. of the individuals in a batch were infected. In 1936, a dog was found naturally infected, and in 1938 two armadillos (*Dasypus novemcinctus mexicanus*). From the fact that 37·5 per cent. or more of the examples of *T. pallidipennis* found in the burrows of *Neotoma* (*Hodomys*) *alleni* were found to be infected with *T. cruzi* and the strain was infective for man [*cf. R.A.E.*, B **27** 264], it is concluded that these animals must also be an effective reservoir. In 1938, two cases of the disease in man were observed in the State of Oaxaca, where the vector is *R. prolixus*, and one accidental

infection in Paris with the strain from *T. pallidipennis* mentioned above [*cf. loc. cit.*]. These cases are described.

In view of the divergence of opinion that exists regarding the mode of transmission of *T. cruzi* [*cf.* **27** 42], the experiments described in the second paper were undertaken to determine whether various American strains of the trypanosome and a *vickersae* strain from Java [*cf.* **23** 161] could be transmitted to mice in the course of the sucking of blood by larvae and nymphs of *T. pallidipes* and *R. prolixus* under conditions in which any contact between the excreta of the bugs and the skin of the mice was rendered impossible, and the contamination of the proboscis of the bugs with excreta was avoided. The technique used is described. No infection was obtained in any of the 52 experiments. The excreta of the bugs were examined, and if metacyclic forms of the trypanosome were found, the excreta or a suspension of the intestine of the bug was injected into one or two mice. The characteristics of the various strains in mice are described.

In the third paper, the author discusses the possible means by which *Trypanosoma cruzi* is transmitted by Triatomids to man, and reviews briefly the results of experiments by various authors that have a bearing on this subject [*cf.* **27** 42]. He concludes that although the usual means is by contamination of the mucous membranes or skin with the excreta of infected bugs, infection by biting does sometimes occur. Since no other worker has recorded the presence of trypanosomes in the salivary glands since C. Chagas originally did so in 1909 and 1911, he considers it unlikely that in cases of transmission by bite they are derived from these organs. It is possible, however, that they may be regurgitated from the stomach or be transmitted owing to the contamination of the proboscis with excreta or as a result of feeding on other infected bugs.

Ristorcelli (A.). **Sur les phlébotomes de l'île de Crète.**—*Ann. Parasit. hum. comp.* **17** no. 4 pp. 355–358, 1 fig., 9 refs. Paris, 1939.

A list is given of the species of *Phlebotomus* found in Crete [*cf. R.A.E.*, B **24** 160 ; **26** 256]. One of them is *P. parroti* var. *italicus*, Adl. & Thdr., the characters of which the author discusses and which he does not consider a distinct variety.

Ristorcelli (A.). **Contribution à l'étude des phlébotomes du Maroc.**—*Ann. Parasit. hum. comp.* **17** no. 4 pp. 364–365. Paris, 1939.

A collection of *Phlebotomus* from southern Morocco comprised *P. papatasii*, Scop., *P. parroti*, Adl. & Thdr., *P. longicuspis*, Nitzu., which has not previously been recorded from Morocco, and *P. papatasii* var. *breviventris*, n., and *P. africanus* var. *cherifianus*, n., which are very briefly characterised, but will be dealt with in greater detail in a subsequent publication.

Yuan (I. C.), Chu (F. T.) & Lee (C. U.). **The seasonal Incidence of Kala-azar in Infants and its Significance in Relation to the Transmission Problem of the Disease.**—*Chin. med. J* **56** no. 3 pp. 241–264, 1 chart, 12 refs. Peking, 1939.

From an analysis of 36 cases of visceral leishmaniasis in infants in Peking, it is concluded that the natural infection of man in North

China occurs in the early part of the summer, probably between mid-May and mid-July, a period that corresponds to the seasonal prevalence of *Phlebotomus chinensis*, Newst. [*cf*. *R.A.E.*, B **16** 169], which has recently been found naturally infected during June and July [**25** 1; **26** 60] and can also be readily infected in the laboratory [*cf*. **15** 177, 178].

Ionescu-Braila (G.) & Dinulesco (G.). **La mouche de Golubatz** (*Simulium reptans* **L.**) **et son action pathogène.**—D.33, 23 pp., 6 figs., 1 fldg map, 2 fldg graphs, 11 refs. Paris, Off. int. Epizoot., 1939.

The authors discuss the outbreaks of the Golubatz fly [*Danubiosimulium columbaczense*, Schönb.], for which they use the name *Simulium reptans*, L., that have occurred in Rumania since 1923 [*cf*. *R.A.E.*, B **12** 190], and attempt to correlate the intensity of the outbreaks, as represented by the number of Departments invaded, with temperature and rainfall as indicated by the annual and quarterly averages and the monthly averages for March, April and May. They conclude that there is no obvious relation between these factors [but *cf*. **25** 249], although there is no doubt that dryness in April may favour the spread of the fly or its persistence in the invaded areas. The symptoms produced by the attacks of the fly on man and animals, based on observations in 1923, are described. Appended is a reprint of Circular 77 (1928) of the Ministry of Agriculture and Lands, in which suggestions are made for the organisation of a service that will supply information regarding invasions of the fly, for measures to protect animals from attack, and for the treatment of animals that have been attacked. Since the fly feeds only between sunrise and sunset, animals should be kept in dark, well-maintained buildings during the day and pastured at night. Agricultural and transport work should also be carried out at night, except on cold and rainy days when the flies do not leave the ground. If it is absolutely necessary for animals to be used during the day, the hairless parts of their bodies, which are those preferred by the fly, should be smeared with a mixture of crude petroleum with fat or oil, and a bucket of burning dung, which produces a repellent smoke, should be suspended from the tip of the pole of the vehicle. Sheep and goats should not be sheared until June, since experience has shown that they are attacked only if this has been done.

Dinulesco (G.) & Foişoreano (D.). **Recherches sur quelques substances larvicides pour les hypodermes.**—*Ann. Inst. nat. zootech. Roum.* **7** (1938) repr. 20 pp., 3 figs., 26 refs. Bucharest, 1939.

In continuation of investigations on *Hypoderma* [*bovis*, DeG.] in Rumania [*R.A.E.*, B **27** 198], the experiments described in this paper were undertaken to test various possible larvicides for application to the warbles. When the materials were placed in contact with larvae taken from warbles, complete mortality was obtained in the shortest time with benzine alone or benzine containing 2 per cent. iodine, and satisfactory results were subsequently obtained when these two materials were injected into warbles on cattle at the rate of 0·5 cc. per warble. The iodised benzine, which is recommended for practical use, may be conveniently applied from a small brass can with a short

slightly conical spout from which a few drops can be forced into the warble by pressure on the sides of the can. Since the treatment cannot be applied until the skin over the warble has been pierced by the larvae, it cannot be carried out until the second half of April, and as the warbles continue to form for the next four months [*cf. loc. cit.*], it should be repeated at monthly intervals until July.

DEONIER (C. C.). **Responses of the Blowflies, *Cochliomyia americana* C. & P. and *Phormia regina* Meigen, to stimulations of the Tarsal Chemoreceptors.**—*Ann. ent. Soc. Amer.* **32** no. 3 pp. 526–532, 3 refs. Columbus, Ohio, 1939.

The experiments described, which were carried out on the same lines as those already noticed [*cf. R.A.E.*, B **27** 102], were undertaken to determine the responses of adults of *Cochliomyia hominivorax*, Coq. (*americana*, C. & P.) and *Phormia regina*, Mg., to solutions of sucrose alone or with the addition of mercury bichloride. The gustatory sense organs of *P. regina* have already been studied [**14** 223].

The following is taken from the author's summary: Adults of *C. hominivorax* were found to have on the tarsi and proboscis gustatory chemoreceptors through which non-volatile substances can be detected. Mercury bichloride was more repellent to this fly in 0·5 than in 1·0 molar sucrose solutions. Adults of *P. regina* 24 hours old were definitely repelled by a concentration of mercury bichloride as low as 0·25 per cent. whereas those 48 hours old were not repelled, although feeding responses were slightly lowered. Variations in the responses of the sexes were not significant. The responses of blowflies free in cages were comparable to those of flies mounted on cubes of beeswax. The flies were found to select solutions for feeding through chemoreceptors on the tarsi. They died of starvation when 2 gm. mercury bichloride per 100 cc. sucrose solution was the only source of nourishment and water. The death rate was higher and the effects of starvation were more rapid in cage tests carried out during the summer months.

CRAWFORD (M.). **Report of the Government Veterinary Surgeon for 1937.**—*Adm. Rep. Dir. Agric. Ceylon 1937* pp. D69 – D79. Colombo, 1939.

Small round protozoal organisms were found in the blood of 14 fowls at Peradeniya. In many respects they resembled *Aegyptianella pullorum* but were situated close to the nucleus of the red corpuscles instead of round the edge. Brumpt considers that they are probably an undescribed species of *Aegyptianella*. *Argas persicus*, Oken, the vector of *Aegyptianella pullorum*, has not been found at Peradeniya [*cf. R.A.E.*, B **27** 58]. The transmitting agent is unknown but is suspected to be a mosquito.

EVANS (I. B. Pole). **Pasture, Crop and Insect Problems of the Union [of South Africa]. Annual Report of the Division of Plant Industry.**—*Fmg in S. Afr.* 1938 repr. no. 105, 20 pp., 11 figs. Pretoria, 1938. [Recd. 1939.]

This report includes a note (p. 18) on a mite that is a troublesome pest of fowls at Glen in the Orange Free State. It had been thought to be *Dermanyssus gallinae*, DeG., but has now been identified as

the tropical rat mite, *Liponyssus bacoti*, Hirst. It is known to be spread by workers who collect the eggs of the fowls, and can be transported on the eggs themselves, while it is probable that it is also distributed by rats. Of various treatments tried, two applications at a week's interval of nicotine (1 : 800) with soap, using either the 40 per cent. sulphate or the 7 per cent. extract, appears to eliminate infestation effectively. In an experiment, the birds themselves were satisfactorily freed from the mites by fumigation with sulphur dioxide, applied from a pressure cylinder in a box that kept out the heads, which were treated with sodium fluoride.

HASE (A.). **Ueber den Pinienprozessionsspinner und über die Gefährlichkeit seiner Raupenhaare.** (*Thaumetopoea pityocampa* **Schiff.**). [On the Pine Processionary and on the Dangerousness of the Hairs of its Larva.]—*Anz. Schädlingsk.* **15** pt. 12 pp. 133–142, 28 refs. Berlin, 1939.

Sections of this paper on *Thaumetopoea pityocampa*, Schiff., in Spain [*R.A.E.*, A **28** 161] deal with the action of the urticating hairs of the larvae on the human skin, mucous membranes and eyes. It is not known whether the hairs contain a poison or whether their action is due to mechanical irritation, but since hairs kept for 12 years caused severe irritation in guineapigs even after immersion for 4 hours in warm alcohol followed by 4 hours in sulphuric ether and heating for 2 hours at 100°C. [212°F.], their action is considered to be mechanical. The diameters of three hairs measured by the author were 6, 5 and 3 microns. They should therefore be able to penetrate the blood capillaries, causing irritation and blocking, and to enter the individual cells. The probable process of penetration into the skin is described.

GLOVER (B. T. J.). **The Use of Heavy Naphtha in Bed-bug Disinfestation.**—*J. R. sanit. Inst.* **59** no. 11 pp. 671–680. London, 1939.

A detailed account is given of the method used in Liverpool for fumigating empty houses with heavy coal-tar naphtha against bed-buds [*Cimex lectularius*, L.]. Since February 1937, 1,494 dwellings have been treated and in only six instances has it been necessary to apply naphtha twice in order to eradicate the infestation. The information is essentially the same as that already noticed [*R.A.E.*, B **25** 177 ; **27** 62]. The floor of the roof-space is covered with sacking or old blankets and sprayed liberally with naphtha, and the trap-door is closed and sealed before the rest of the house is fumigated. The house is then treated from above downwards, so that the last area treated is that contiguous to the door chosen for exit. For use in heavily infested rooms, where it is thought desirable to maintain the concentration of vapour at a high level throughout the 18–24 hours of treatment, a sprinkler has been devised by means of which additional naphtha can be sprayed in a sealed room at a given time. The usual plan is to set the clockwork mechanism to release up to one gallon 9–11 hours after the room has been sealed. The naphtha is flung on to the cotton screens [*cf.* **27** 62] by a mechanical system of whirling arms. The lethal vapour concentration needed to ensure the death of bugs within 18 hours is 0·15 per cent. In the presence of sufficient liquid, the vapour concentration of commercial naphtha is 0·16 per cent. at 50°F. rising

to 0·36 at 75°F. For this reason the temperature in the building to be treated should not be below 60°F.

Long practical experience with the staffs used in fumigation work has confirmed the assumption that the vapour is not toxic to man. Masks are, however, worn during the work because the concentrated vapour and fine droplets of the liquid are very irritating to the eyes, nose and throat. The only damage has been that caused to certain classes of cheap paint in which the solvent is naphtha. These were spoiled when the liquid was sprayed directly on to them, but since they are not affected by the vapour the damage is obviated by spraying on to the cotton screens. In heavily infested rooms, one floorboard is lifted to facilitate penetration of the vapour under the floor, but it is very seldom necessary to ease skirting boards or architraves, which involves relatively costly repairs. Since the naphtha is harmless to man, it is unnecessary to order that contiguous houses shall be vacated, although the inhabitants are warned so that they shall not be alarmed when they notice the smell of naphtha. Details are given of the cost and sources of equipment and materials, and the average cost of treating a house.

GALLIARD (H.). **Recherches sur la transmission de** *Filaria bancrofti* **et** *F. malayi* **au Tonkin (note preliminaire).**—*Acta Conv. ter. trop. Malar. Morb.* **1** pp. 228–229. Amsterdam, 1938. [Recd. 1939.]

A brief summary is given of the work that has been carried out in Indo-China on the development of *Filaria bancrofti* and *F. malayi* in various species of mosquitos, some of which has already been noticed [*R.A.E.*, B **25** 5, 26; **27** 28]. Five out of 8 examples of *Mansonia* (*Mansonioides*) *indiana*, Edw., that died 8–13 days after the infecting feed contained larvae of *F. malayi* that were at the normal stage of development for the temperature at which the experiment was carried out, but no infection was observed in 5 examples of *M.* (*M.*) *annulifera*, Theo. Normally developed forms of *F. malayi* were found in half the specimens of *Anopheles* (*Neocellia*) *maculatus*, Theo., and of *A.* (*Pseudomyzomyia*) *vagus*, Dön., dissected, but none had survived long enough for infective larvae to be present. Since 90 per cent. of the females of *A. hyrcanus* var. *sinensis*, Wied., become infected whether they are fed on persons infected with *F. bancrofti* or *F. malayi*, it seems probable that this Anopheline, which is present throughout Tonkin, is the most important vector of filariasis. It is more efficient than *Culex fatigans*, Wied., in the case of *F. bancrofti* and is important in the transmission of *F. malayi* owing to the rarity of species of *Mansonia* of the subgenus *Mansonioides*.

FENG (Lan-Chou). **The Distribution and Transmission of Filariasis in China.**—*Acta Conv. ter. trop. Malar. Morb.* **1** pp. 239–248, 1 map, 22 refs. Amsterdam, 1938. [Recd. 1939.]

This is a brief review of the somewhat limited data on the incidence of filariasis in China, where both *Filaria* (*Wuchereria*) *bancrofti* and *F.* (*Microfilaria*) *malayi* occur, and on the mosquitos concerned in its transmission. It is concluded that both infections are present in central and south China, both are widely distributed and both are prevalent chiefly in low-lying areas near lakes and large rivers inland and on the coast. They also appear to occur more frequently in rural

than in urban populations. This is probably because *Anopheles hyrcanus* var. *sinensis*, Wied., which is found throughout China and transmits both parasites, *Mansonia uniformis*, Theo., which is concerned in the transmission of *F. malayi* and *Culex pipiens* var. *pallens*, Coq., and *C. fatigans*, Wied., which transmit *F. bancrofti* in central and south China, respectively, are all present in rural areas, whereas only the last two are found in urban areas.

FENG (Lan-chou) & CHUNG (Hwei-lan). **The Transmission of** *Spirochaeta duttoni* **by** *Ornithodorus moubata*.—*Acta Conv. ter. trop. Malar. Morb.* **1** pp. 438–443, 8 refs. Amsterdam, 1938. [Recd. 1939.]

In continuation of their work on the development of *Spirochaeta duttoni* in *Ornithodorus moubata*, Murr., and the ways in which it is transmitted [*R.A.E.*, B **25** 24 ; **26** 146], the authors carried out the experiments described in this article, which confirm their previous conclusions that the spirochaetes are transmitted by biting, and by the coxal fluid passed during feeding, but not by the faeces. Batches consisting of 15–40 heavily infected ticks were allowed to feed on 7 mice. When they began to swell, but before any coxal fluid or faeces had been expelled they were removed. One or two ticks of each batch were dissected so that the degree of infection of the salivary glands could be determined. Four out of seven mice became infected, and only one of the other three lived long enough for the incubation period of the spirochaete. The fact that spirochaetes were not numerous in the salivary glands of the ticks fed on this mouse may have accounted for the negative result. In a second series of experiments, infected ticks were fed on mice and the coxal fluid collected during the feeds was injected into other mice, all of which became infected. Coxal fluid from heavily infected ticks, which contained a large number of spirochaetes, produced infection in mice in 6–7 days, whereas fluid from lightly infected ticks, which contained fewer spirochaetes, produced infection in 11 days. Examination of the faeces of still more ticks [*cf.* **25** 24] having heavy infections of different durations again failed to reveal the presence of spirochaetes, although many were present in the coxal fluid of the ticks and in the organs, with the exception of the stomach and Malpighian tubes. Negative results were also obtained when fresh faeces were injected into animals, even though the faeces from up to 10 ticks were used in some cases.

VAN HOOF (L.), HENRARD (C.) & PEEL (E.). **Mekanische prophylaxie der slaapziekte. Strijd tegen de glossinen in Belgisch Congo.** [The mechanical Prevention of Sleeping Sickness. Work against *Glossina* in the Belgian Congo.]—*Acta Conv. ter. trop. Malar. Morb.* **1** pp. 641–649. Amsterdam, 1938. [Recd 1939.]

Legislation in connection with sleeping sickness in the Belgian Congo prescribes measures designed to prevent the breeding of tsetse flies. Clearing is a practical and economical measure if its application can be confined to specialised breeding places in restricted areas ; it is therefore chiefly valuable against *Glossina palpalis*, R.-D., owing to the close association of this species with the forested banks of streams. The natives are increasingly forsaking their paths for European-made roads, and are chiefly exposed to infection in and around their villages,

where the fly is combated by specially trained natives. This organisation has been developed in the districts where sleeping sickness is endemic.

There are several records in the Congo of local decrease or even disappearance of the disease. It is known that the trypanosome infecting man can lose its cyclical transmissibility [*R.A.E.*, B **26** 186], and that flies decrease in abundance owing to increased cultivation or the disappearance of animals associated with water.

In view of the good results given by Harris traps against *G. pallidipes*, Aust., in Zululand [see next paper], these traps have been used since 1931 against *G. palpalis* and *G. morsitans*, Westw., the two most important species in the Belgian Congo. In the Lomani region, Dr. Marchi placed the traps where flies were abundant and caught large numbers. Subsequently, Dr. Mercken, wishing to test their efficiency in places frequented by man and animals, placed them along paths and at boat landings, where flies were less numerous, and his catches were scanty. One of the authors (Henrard) experimented with various types of Harris traps and considered that they were of value, though they could not eradicate flies, and that the presence of man increased the catches [**23** 13].

In another test, concluded in 1936, in a region in which *G. palpalis* overwhelmingly predominated, the numbers of flies caught by traps were less than those caught by fly boys, and the traps required a large and competent personnel. During 4 months, 60 traps in the best situations that could be found in thick forest caught 860 tsetse flies, while 6 fly boys, working outside the zone of attraction of the traps, caught 4,843. However, medical men who collaborated in this experiment confirmed that the index of new cases in the district fell from 7·5 per cent. in 1934 to 1 per cent. in 1936, and arranged for traps to be used in the Kamwandu region, where sleeping sickness had not been controlled.

In the very wide region in which *G. palpalis* occurs, the traps should be of more use in protecting cattle than in protecting natives. Open spaces favour traps, and only the drinking places need clearing. Cattle can be kept away from the wooded banks of rivers by fencing and so contact with tsetse flies can be practically eliminated. In the authors' opinion, Harris traps are useful against *G. palpalis* and *G. morsitans* as well as against *G. pallidipes*, but require a special technique for each species. Their application is especially difficult in the case of *G. palpalis*, which lives in thick bush and finds food easily. The work must follow two principles: mass destruction in places where flies abound, and specific destruction in dangerous breeding places in order to protect draught animals.

HARRIS (R. H. T. P.). **The Control and possible Extermination of the Tsetse by Trapping.**—*Acta Conv. ter. trop. Malar. Morb.* **1** pp. 663–677. Amsterdam, 1938. [Recd. 1939.]

The author briefly discusses the phototropic responses of tsetse flies, the necessity for altering any trap that depends on visual impression so that it gives that degree of light and shadow to which a particular species of fly most readily responds, and the importance of placing a trap in a situation in which the optimum conditions of light and shadow are obtained and persist for as long a period as possible during the day. He then describes the standard Harris trap, which has been

used with success in the control of *Glossina pallidipes*, Aust., in Zululand [*cf.* *R.A.E.*, B **19** 78], and discusses the effect of trapping on fly population. He has found that when additional traps are placed in an area in which the numbers of flies caught in the original traps has already been considerably reduced, they may, for a time, catch larger numbers than the other traps. This may be explained by the fact that the fly is definitely localised and does not travel extensively unaided. When the fly-density of an area is high, the flies disperse by force of numbers, but when this density is reduced by trapping, they are transported from one locality to another chiefly by wild animals. In an attempt to restrict the wanderings of such animals, several miles of hessian screens have been erected since November 1937. They are arranged so that no animal can see below them or over the top. No animal, when unmolested, has yet made any attempt to get through the screens. As it is thus possible to prevent animals from carrying flies into an area that has been cleared by intensive trapping, the traps need not be left to deal with these occasional flies and can be used elsewhere. Tables are appended showing the numbers of flies caught in traps in the Umfolosi area [*cf.* **21** 22] in each month from January 1931 to April 1938. The average numbers caught daily in each trap during these years were 40·7, 3·3, 4·4, 2·1, 0·4, 0·07, 0·01 and 0·002 (for the first three months of 1938), respectively. The average numbers of traps in daily operation were 487, 351, 951, 1,356, 2,019, 4,061, 8,928, and 10,714. Thus, well over 7 million flies were caught in 1931, as compared with about 57,000 in 1937.

Reichenow (E.). **Ueber die Entwicklung des Erregers des Küstenfiebers der Rinder und die Pathogenese dieser Krankheit.** [On the Development of the Causal Agent of African Coast Fever of Cattle and the Pathogenesis of this Disease.]—*Acta Conv. ter. trop. Malar. Morb.* **1** pp. 681–687. Amsterdam, 1938. [Recd 1939.]

African Coast fever of cattle is the most important form of piroplasmosis and the only one against which inoculation and chemotherapy have failed to give protection. It is therefore the most serious disease of cattle in extensive regions of East Africa, yet little is known regarding its causal agent, *Theileria parva*. The results of work by Cowdry and Ham in Kenya on the life-cycle of *T. parva* in the vector tick, *Rhipicephalus appendiculatus*, Neum. [*R.A.E.*, B **19** 35; **20** 137] are summarised; according to their observations, its development is on the whole similar to that of malaria parasites in Anophelines.

The author considered it desirable to make a further study of the development of *T. parva*, in view of the fact that research by himself and Regendanz [**21** 76] showed that *Piroplasma* (*Babesia*) *canis* had a completely different developmental cycle from that of the Haemosporidia. His observations on *T. parva* were made in 1937 in Tanganyika and showed that the processes in the tick were much simpler than those reported by Cowdry and Ham. No development occurs in the gut wall. Forms described from it are misidentifications, partly of enclaves in the epithelial cells that originate during intracellular digestion, and partly of forms arising from the cell degeneration that occurs in connection with the metamorphosis of the tick. Furthermore, the forms without detectable nuclei identified as " sporonts "

do not belong to the development of *Theileria*, but to that of the gland cell, and represent stages in the formation of the gland secretion.

Of the enormous numbers of minute *Theileria* in the gut of the tick, only a very few succeed in reaching the salivary gland cells through the gut wall. There they begin to develop as soon as the tick, after metamorphosis, begins to suck blood. They increase by division into two, as in the case of *Piroplasma*, and at first they distribute themselves singly between the drops of secretion in the cells. When they increase further, they form, between the drops, masses that increase in size continually. When the secretion is discharged, the parasites can be seen laid ringwise in the cavities. These are the forms that Cowdry and Ham described as sporozoites on the surface of the sporoblasts. Later on, the parasites fill the whole cell. The chromatin has now thickened to a compact mass. Finally the host cell bursts and voids its contents into the lumen of the salivary gland, and from there the parasite reaches the puncture in the vertebrate host with the saliva of the tick. The whole process of increase is completed within 3 days.

The author considers *R. appendiculatus* to be the most important vector of African Coast fever. Though *R. evertsi*, Neum., has transmitted *T. parva* experimentally [**26** 26], the disease is absent from the regions near Lake Victoria where this tick is present but *R. appendiculatus* is absent. The unsuitability of *R. evertsi* for the transmission of *Theileria* is due in part to its mode of development. It is a two-host tick, the nymph remaining on the animal to which the larva became attached. *R. evertsi* can therefore act as a vector only in the adult stage, whereas *R. appendiculatus*, which is a three-host tick, has two opportunities for transmission. Furthermore, the larval and nymphal stages remain on the first host for about 14 days, and if the animal is infected when the larva attaches itself it will usually die before this period has elapsed. The author did not obtain transmission of the disease in an experiment with 17 adults of *R. evertsi*, whereas he always did so in his experiments with *R. appendiculatus*.

FRATANI (L.). **Etude épidémiologique du paludisme à Beni Abbès (Sahara oranais) en 1937.**—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 429–437, 2 pls., 1 map., 5 refs. Algiers, 1939.

An account is given of malaria at Beni Abbès (in the southern part of the Department of Oran, Algeria), with particular reference to the epidemic that occurred in 1937. The Anophelines found there are *Anopheles multicolor*, Camb., *A. hispaniola*, Theo., *A. sergenti*, Theo., and *A. dthali*, Patton. The most important breeding places are the permanent pools fed from the subsoil water-table [*cf. R.A.E.*, B **4** 156–157], which are sheltered from the wind in the sandy bed of a stream, where tamarisk, reeds and rushes grow, but breeding also occurs in the pools left by the flood waters and in small reservoirs and disused wells. In view of the irregularity of the time and extent of the floods and of the variations in the course of the stream in its wide bed, it is impossible to carry out permanent anti-larval measures on a large scale, and work must be limited to the filling of small pools, clearing vegetation from and oiling larger pools, and draining away water by constructing a straight canal between the large pools. This work can be carried out by a small number of labourers and can be maintained throughout the summer and autumn by even fewer. *Gambusia* was introduced and the fry of a local fish, *Barbus figuiensis*,

were found to destroy mosquito larvae. No larvae were found in the pools in which they were present, and although they are less active than *Gambusia*, they are well adapted to local conditions. The reservoirs should be completely emptied and cleaned frequently. The owners of abandoned wells should be made to use them every five days or to fill them in ; if this is not done, they should be oiled.

LE GAONACH (J.). **Un foyer de paludisme au Hoggar (Tahifet).**—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 438–441, 1 pl., 3 refs. Algiers, 1939.

A study of the epidemiology of malaria among the settled population of the Hoggar was carried out in October 1938 in the small village of Tahifet, which is situated in the bed of the Tahifet Wadi at an altitude of about 5,000 ft. As many as 17 out of 22 persons selected at random from the population of 130 harboured malaria parasites. Suitable breeding places for Anophelines were found among the vegetation at the edges of the streams and pools used for irrigating the gardens. The only species identified was *Anopheles sergenti*, Theo., which shows that the distribution of this species extends to the central Sahara.

COLLIGNON (E.). **La campagne antipaludique de 1938 dans le département d'Alger.**—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 442–456, 5 pls., 2 graphs. Algiers, 1939.

AMBIALET (R.). **La campagne antipaludique de 1938 dans le département de Constantine.**—*T.c.* pp. 457–466, 4 pls.

Accounts are given of the work carried out and the results obtained in the campaigns against Anophelines and malaria in 1938 [*cf. R.A.E.*, B **27** 118]. A general outbreak of malaria that occurred at the beginning of July in the Department of Constantine was due to the abundant rains in May and June, which led to an increase in the size and persistence of pools in water courses in which Anophelines bred. It will be necessary in future to have bands of workmen ready to deal immediately with such pools, though the small breeding places such as springs, irrigation canals, etc., are little influenced by rainfall and hardly undergo any variations from year to year. In the Department of Algiers, the prompt application of anti-larval measures offset to a large extent the effects of breeding places created by the abnormal rainfall in May, but a short outbreak of malaria in July again emphasised the influence of climatic conditions and the necessity for continuous measures to combat Anopheline breeding.

RAMES (C.). **Sur l'existence du bouton d'orient à Beni Abbès (Sahara oranais).**—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 482–483, 1 pl., 5 refs. Algiers, 1939.

The author describes a case of dermal leishmaniasis that occurred at Beni Abbès (southern Oran). The sandflies found there are *Phlebotomus papatasii*, Scop., *P. parroti*, Adl. & Thdr., and *P. fallax*, Parr.

MARTIN (R.). **Observations sur les phlébotomes d'Ethiopie (deuxième mémoire).**—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 490–501. Algiers, 1939.

This paper, which records further observations on the sandflies of Abyssinia [*cf. R.A.E.*, B **27** 34, etc.] is divided into three parts.

The first part deals with the seasonal prevalence and bionomics of *Phlebotomus longipes*, Parr. & Martin, the adults being observed in nature and the immature stages in the course of rearing. This species has so far been taken only at Addis Ababa, but represented about 97 per cent. of the sandflies caught there between February 1938 and March 1939. It does not appear to be concerned in the transmission of disease, since sandfly fever and visceral leishmaniasis are not known to occur at Addis Ababa and cases of dermal leishmaniasis that are found there are all contracted elsewhere, but as it belongs to the group of *P. major*, Annan., it should be regarded with suspicion. In the second part, a list is given of the 20 species and varieties of *Phlebotomus* that have been recorded from Abyssinia [**24** 160; **27** 34, 234; **28** 80] showing the localities and altitudes at which they have been taken. In the third part, the author discusses the types of lesion that have been observed to follow the bites of sandflies; these usually occur in persons that have recently arrived in the country or in particularly susceptible persons.

ROARK (R. C.). **Chemistry in Pest Control.**—*Soap* **15** no. 11 pp. 93, 95, 97, 123, 1 fig. New York, N.Y., 1939.

The author briefly discusses the more common chemical products that are used in the control of pests, bringing out such points as the forms in which they are usually obtainable, the pests against which they are chiefly used, the ways in which they are applied and their toxicity to man and animals.

STODDARD (R. B.). **What of Moribund Kill?**—*Soap* **15** no. 10 pp. 93, 95, 97. New York, N.Y., 1939.

WHITMIRE (H. E.). **Test Methods for recording Moribund Kill.**—*T.c.* no. 11 pp. 99, 101, 103, 123, 2 figs.

The Peet-Grady method [*R.A.E.*, B **16** 255] of testing household insecticides on house-flies [*Musca domestica*, L.] was designed when the only insecticidal material being seriously considered was pyrethrum, which has a rapid paralytic action on flies. At present, numbers of other materials are used, some of which have a much less rapid but no less effective insecticidal action, and the author of the first paper points out the desirability of modifying the interpretation of the results of the tests to include among the dead flies those that are moribund at the end of the 24 hours. He also suggests that a record should be kept of the "knockdown" at the end of 5 as well as of 10 minutes.

The author of the second paper points out that in using Peet-Grady and other tests for the comparison of different materials, he has for the past five years taken into consideration the proportion of moribund flies. Two methods have been used to define "moribund." In the first, which involves no modification of the method, the flies are placed on a piece of paper 18 ins. square at the end of 24 hours, and those that can make any movement but fail to fly or walk off the piece of paper are classed as moribund. In the second, the flies knocked down in the first 10 minutes are stored in small cages with open tops placed in a cabinet. At the end of 24 hours, those flies are considered moribund that are alive but have not escaped from the cages.

de la Paz (G. C.). **Our common Houseflies, their Importance as Disease Transmitters, and their Eradication.**—*Mon. Bull. Bur. Hlth Philipp. I.* **19** no. 5 pp. 219–230, 24 refs. Manila, 1939.

A brief and somewhat popular account is given of the flies that frequent dwellings and places where food is handled in the Philippines. The most common are *Musca domestica vicina*, Macq., *M. sorbens*, Wied., *Chrysomyia megacephala*, F., and *Sarcophaga ruficornis*, Wied., in the order of their abundance. The subjects dealt with include the morphology and life-history of flies in general, the breeding places of domestic flies, their habits, seasonal prevalence, range of flight, relation to disease, natural enemies and control.

Papers noticed by Title only.

Nicholls (L.). **The Relation of Tsetse-fly Control to Forestry** [summary of work on clearing and densification for the control of *Glossina*].—*For. Abstr.* **1** no. 2 pp. 63–69, 10 refs. Oxford, 1939.

Atkey (O. F. H.). **Distribution et incidence de l'***Aëdes aegypti* **au Soudan Anglo-Egyptien en 1938** [list of locality records].—*Bull. Off. int. Hyg. Publ.* **31** no. 9 pp. 1588–1589. Paris, 1939.

Senevet (G.) & Abonnenc (E.). **Les moustiques de la Guyane.—IV. Le genre** *Aëdes* [including keys based on adults, male hypopygia and larvae].—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 467–480, 8 figs. Algiers, 1939. [*Cf. R.A.E.*, B **28** 16.]

Parrot (L.) & Martin (R.). **Notes sur les phlébotomes. XXX.—Une variété nouvelle de** *Phlebotomus sergenti* [var. *sacvus* n.], **d'Ethiopie.**—*Arch. Inst. Pasteur Algérie* **17** no. 3 pp. 484–489, 6 figs., 10 refs. Algiers, 1939.

Ristorcelli (A.). **Présence à Melun (Seine-et-Marne) de** *Phlebotomus perniciosus*.—*Ann. Parasit. hum. comp.* **17** no. 4 p. 364, 1 ref. Paris, 1939. [*Cf. R.A.E.*, B **25** 96.]

Simmons (S. W.). **Digestive Enzymes of the Larva of the Cattle Grub** *Hypoderma lineatum* **(De Villiers).**—*Ann. ent. Soc. Amer.* **32** no. 3 pp. 621–627, 13 refs. Columbus, Ohio, 1939.

Cox (H. R.). **Studies of a filter-passing Infectious Agent isolated from Ticks** [*Dermacentor andersoni*, Stiles]. **V. Further Attempts to cultivate in Cell-free Media. Suggested Classification** [as *Rickettsia diaporica*, sp. n.].—*Publ. Hlth Rep.* **54** no. 40 pp. 1822–1827, 5 refs. Washington, D.C., 1939. [*Cf. R.A.E.*, B **27** 146.]

Bliss (C. I.). **The Toxicity of Poisons applied jointly.**—*Ann. appl. Biol.* **26** no. 3 pp. 585–615, 14 figs., 13 refs. London, 1939. [See *R.A.E.*, A **28** 199.]

Shepard (H. H.). **The Chemistry and Toxicology of Insecticides.**—$10\frac{3}{4}\times8\frac{1}{4}$ ins., iii+383 pp., 40 figs., multigraphed, many refs. Minneapolis, Minn., Burgess Pub. Co., 1939. Price $4·00. [See *R.A.E.*, A **28** 147.]

Dinulescu (G.). **Studiu asupra factorilor de depreciere a pieilor industriale în România. Valoarea pagubelor produse.** [Study of the Factors depreciating commercial Hides in Rumania. Valuation of the damaged Products.]—*Bul. Asoc. Med. vet. Român.* **50** (1938) no. 10–12 repr. 39 pp., 23 figs., 7 refs. Bucharest, 1939.

In view of the heavy losses caused to the tanning industry in Rumania owing to the poor quality of hides, a survey, based on investigations by the author in 1936–38 and by other workers, is given of the various factors that are responsible for the injury to the skins of cattle, horses and sheep. These include damage by insects to hides in storehouses and injury in the field due to attack by various Arthropods. Ticks, which are widely distributed in Rumania, produce pustules on the sides of the neck and on the lower region of the body of the animals and cause numerous perforations in the skins. Mange-mites and lice, which occur on cattle, horses and sheep and chiefly attack weak or ill-kept animals, cause the hair to drop. The skin is injured because the animals rub themselves against hard objects, and the mites also mine under the epidermis and produce wrinkles, erosions and pustules. Considerable damage is caused by larvae of *Hypoderma* in cattle [*cf. R.A.E.*, B **27** 198], and by blowfly larvae in sheep. The skins of animals that have been attacked by blood-sucking Diptera, such as *Stomoxys calcitrans*, L., Simuliids and Tabanids, show no evident injury, but are stated to crack in the process of tanning.

Jack (R. W.). **Studies in the Physiology and Behaviour of** *Glossina morsitans*, **Westw.**—*Mem. Dep. Agric. S. Rhod.* no. 1 [Correction 11th March 1940] 1 p. multigraph, 2 refs. Salisbury, 1940.

In this correction of a small section of a paper already noticed [*R.A.E.*, B **28** 23] on *Glossina morsitans*, Westw., in Southern Rhodesia, the author points out that other workers give 3–3½ days for the embryonic period and 4–5 days for the larval period [*cf.* **25** 135]. The first larval instar has been stated to last only a few hours and it has been suggested that the moult to the third instar occurs shortly before the larva is expelled. The author's observations confirmed the fact that the females usually take a large blood meal about 3 days before larviposition and do not feed again before the larva has been deposited. Thus, this meal will normally be taken when the larva is about two days old and presumably in the early part of the second instar and not at the end of this instar or the beginning of the third, as was suggested in the original paper. It is estimated that at this period the larva should measure less than 3 mm. in length. In general, female flies should therefore not be attracted to a host when the larva is in a more advanced stage. In the various tables included in the original paper many small second-instar larvae were classified as first-stage larvae ; any larva classified as second-stage measured 2 mm. or more in length.

Dissection of considerable numbers of females of *G. pallidipes*, Aust., caught on a donkey revealed no higher percentage of females containing larvae in an advanced stage of development than among those caught on man. This emphasises the fact that females are not normally attracted to a host when they are in an advanced stage of pregnancy, although they may be so attracted if they have failed to obtain their pre-larviposition meal at the correct time. Females of *G. morsitans*

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containing third-instar larvae showing black lobes have been caught feeding on man and animal, but only exceptionally. The capture on man or animal of any considerable proportion of females containing larvae in an advanced stage, far from indicating a thriving fly community, would seem to indicate a lack of sufficient opportunities for feeding.

LEESON (H. S.). **Longevity of *Anopheles maculipennis* race *atroparvus*, van Thiel, at controlled Temperature and Humidity after one Blood Meal.**—*Bull. ent. Res.* **30** pt. 3 pp. 295–301, 2 figs., 6 refs., London, 1939.

The following is the author's summary: From January to July 1938, experiments with *Anopheles maculipennis* race *atroparvus*, van Thiel, were undertaken to discover whether humidity and the age at which females fed influenced their longevity. It was found that they lived longer at higher than at lower humidities; that most of the females which fed did so in the first three days; that those which fed on the second day after emergence lived longer than those which fed at other ages; and that the feeding period was slightly extended in the later experiments, though only a small proportion lived long enough to take their first blood meals on the fourth and fifth days. Rather more than 50 per cent. of each batch of newly emerged adults were females. A large proportion of the deaths of unfed males and females occurred during the first three days, most of them on the second day; this mortality decreased in successive experiments. *Culex fatigans*, Wied., behaved similarly.

STEPHANIDES (T.). **Corfu *Phlebotomus* (Dipt. Psychod.) found in Human Habitations.**—*Bull. ent. Res.* **30** pt. 3 pp. 303–304. London, 1939.

Brief notes are given on collections of sandflies (totalling 1,066 individuals) made in houses in six different localities in Corfu, Greece, during 1936 and 1937. *Phlebotomus papatasii*, Scop., was the most abundant species and was taken throughout the 24 hours. *P. major*, Ann., and *P. sergenti*, Parr., were fairly plentiful in the country, but extremely rare in the town of Corfu; they were taken most frequently at night. *P. tobbi*, Ald., Thdr. & Lour., *P. minutus*, Rond., and *P. parroti*, Adl. & Thdr., were very rare in all localities; they were taken during the day.

LEWIS (E. A.). **Observations on *Glossina fuscipleuris* and other Tsetses in the Oyani Valley, Kenya Colony.**—*Bull. ent. Res.* **30** pt. 3 pp. 345–358, 2 pls., 1 map, 4 refs. London, 1939.

A detailed account is given of an investigation of the tsetse-fly infestation of the Oyani valley, in the South Kavirondo native reserve, Kenya Colony. After describing the vegetation of the valley, the author discusses the distribution and density of the flies along the Oyani and its tributaries. Four species were found, namely *Glossina pallidipes*, Aust., *G. fuscipleuris*, Aust., *G. brevipalpis*, Newst., and *G. palpalis*, R.-D., and since they differ in habits, so far as these are known, the problem of reclamation is complicated. Further study of their bionomics is required before appropriate measures of eradication

can be recommended. It seems clear that no one method of control, except the complete destruction of forest, which would be uneconomical and undesirable, can yet be employed in such a mixed fly belt with any assurance of success, but a general policy of protection, gradual reclamation and progressive development is suggested.

The puparium of *G. fuscipleuris* is described, and details of a few typical breeding places of this species are given [*cf. R.A.E.*, B **26** 27]. Clumps of dense thicket appear to provide the most suitable conditions for breeding; the interior of the most favoured clumps was heavily shaded and damp, and they were nearly impenetrable to man. It is estimated that about 45 per cent. of the puparia of *G. brevipalpis* and about 20 per cent. of those of *G. fuscipleuris* were parasitised in nature by *Trichopria capensis* var. *robustior*, Silv. Tests in which puparia of the four species of *Glossina* were exposed to this Diapriid indicated that it prefers the puparia of the larger species, since only one puparium of *G. pallidipes* was attacked and none of those of *G. palpalis*. W. P. Langridge, who is studying the development of the parasite, has ascertained that the duration of the life-cycle varies from 18 to 25 days, and that the adult lives for about 10 days under artificial conditions and is readily killed by exposure to direct sunlight.

Whitfield (F. G. S.). **Air Transport, Insects and Disease.**—*Bull. ent. Res.* **30** pt. 3 pp. 365–442, 3 maps (1 fldg), 11 pp. refs. London, 1939.

This paper consists largely of a review of the literature on all subjects that have a bearing on the carriage of insects by aircraft and the economic necessity for its control. The subjects discussed comprise: the risk of transport of vectors of malaria and yellow fever from one country to another (in which connection the history of the introduction of *Anopheles gambiae*, Giles, into Brazil is summarised, and work on the epidemiology and vectors of yellow fever published after 1927 is reviewed); the air lines of the world, which are shown on a detailed folding map; the flight range of insects in connection with the possibility of rendering airports insect-proof; the insect population of the air in connection with the possibility of insects entering aircraft during flight; the ability of insects to survive in aircraft; the records of insects found in aircraft (including those obtained by the author from aircraft landing at Khartoum between July 1935 and August 1938), which are shown in a table covering 13 pages and indicating the insect identified as nearly as possible, the author of the record, number of insects, date and locality of collection, type of aircraft and its place of origin; and the control of insects in aircraft, including suggestions for methods by which this may be accomplished. Lines on which future research might be carried out are briefly indicated.

Kingsbury (A. N.). **Annual Report of the Malaria Advisory Board (F.M.S.) for the Year 1938.**—Med. 8vo, 22 pp., 2 pls. Kuala Lumpur, 1939.

The work accomplished and the information obtained in 1938 on various investigations connected with malaria and its control in Malaya are briefly reviewed [*cf. R.A.E.*, B **27** 10]. Much of the information is only of local interest, and some has already been noticed [**27** 210]. Although the statistics on malaria incidence in Malaya are not very

reliable, they indicate that it was high in 1938. The autumn wave in 1937 was high and sustained, so that the number of gametocyte carriers in the early months of 1938 was probably larger than usual, the rainfall for the year was unduly low, and it is also believed that the replanting of rubber was an important factor in causing the increase [*cf.* **27** 210; **28** 6, 63].

The results of laboratory tests of proprietary mixtures of oils against Anopheline larvae are briefly reviewed. Experiments on the addition to oiling mixtures of a small quantity of pyrethrum extract showed that when it is used with the more active oils, such as those recommended for larvicides, the larvae die more rapidly, but the ultimate mortality is not increased. When, however, it was used with an oil of high boiling range (Diesel II) the mortality was definitely increased, and also apparently the power of the oil to penetrate the tracheae of the larvae. It has been found that when this oil had entered the main tracheal trunks, many larvae were able to pupate and adults finally emerged; when third-instar larvae were used, about half those that had oil in the tracheae immediately after contact with the film completed their development. The addition of pyrethrum greatly reduced the proportion surviving. The view that a larva that has oil in its tracheae is bound to die does, however, appear to be true, at least with fourth-instar larvae, for the oils normally employed as larvicides.

Fascine drainage [*cf.* **22** 149] has proved highly effective in one area, and certain drains for which rubber-tree branches were used are still functioning perfectly after 6 years. A very localised outbreak of malaria occurred in Lower Perak during 1938; larval surveys and the trapping of adults indicated that *Anopheles barbirostris*, Wulp, was the vector, although no infected females were found.

HACKETT (L. W.) & BATES (M.). **The Laboratory for Mosquito Research in Albania.**—*Acta Conv. ter. trop. Malar. Morb.* **2** pp. 113–123, 4 figs. Amsterdam, 1938. [Recd. 1939.]

In view of the fact that few laboratories for studying Anophelines exist in malarious regions where they are abundant, the authors describe the arrangements that have been made for studying them in the laboratory under controlled conditions, in the open under conditions more or less resembling those obtaining in nature, and in the field in Albania, where at least 7 species occur and *Anopheles maculipennis*, Mg., is represented by races *maculipennis* (*typicus*), *messeae*, Flni., *subalpinus*, Hackett & Lewis, and *sacharovi*, Favr.

A cage of wire screening about 33 ft. long, 16 ft. wide and 19½ ft. high, supported on telegraph poles, is used for studying behaviour [*cf.* *R.A.E.*, B **25** 4]. It is large enough to contain a number of structures that can be built or taken down at will, and in the initial experiment it contained a small one-roomed house, a garden with a tree, a pool of water, a calf stable and some rabbit hutches. These are to be replaced by a brick building consisting of 3 identical rooms constructed for experiments on host-preferences, and some shallow concrete pools in which different combinations of aquatic plants growing in shallow pots can be assembled to test their possible influence on egg-laying, etc. It has been found, however, that the populations in the larger cage do not maintain themselves, either because of excessive mortality or restricted water surfaces, and a windowless insectary was therefore

constructed with a small room for mosquitos in cages and two (about 13 by 6½ ft. and 8 ft. high) in which they can be liberated. These rooms are adapted to certain observations not possible in the large cage and are yet not too small to admit the introduction of larger animals as food for species and races that do not readily feed on man or small animals. Experiments with various colours, rhythms and intensities of illumination finally produced conditions in which race *sacharovi* and *A. superpictus*, Grassi, would reproduce readily in them. Not infrequently, fertile eggs of race *maculipennis* were obtained, but pairing was not observed and the number of eggs was insufficient to maintain a colony.

As, however, it was impossible to have enough rooms for the number of colonies it was desired to maintain and the finding of Anophelines and eggs in them was time-consuming and apt to be incomplete, attempts were made to use still smaller cages (20 inches square and 40 inches high). Light conditions in the small cages were varied, and a diffuse blue-green light of low intensity inside the cage in a dark room was found to stimulate swarming. The temperature is kept at about 25°C. [77°F.], and a relative humidity above 80 per cent. always seems to be favourable. Arrangements made for the breeding of the mosquitos within the cage are described. Colonies of *A. superpictus* and of the Italian race *labranchiae*, Flni., were easily established and have now maintained themselves for two years. The same technique has proved successful in Egypt for rearing *A. pharoensis*, Theo., and *A. multicolor*, Camb., but not *A. coustani*, Lav., and *A. sergenti*, Theo. For a period of 12 hours the mosquitos are immobilised by a central lamp giving a light intensity of more than 50 candles in all parts of the room. After about an hour of complete darkness, the blue-green illumination is produced within the cage for 3 or 4 hours. Since males of the Italian race *labranchiae* will swarm in these cages, it is now possible to use them in hybridisation experiments. The typical race *maculipennis* will pair regularly and lay fertile eggs only in the large cage, and race *sacharovi* will swarm in an insectary cubicle, but not in any smaller space; races *messeae*, *melanoon*, Hackett, and *subalpinus* have not been known to pair in any conditions contrived by the authors. As the insectary in which the colonies were kept responded too rapidly to changes in temperature out-of-doors, a subterranean room was constructed, 6½ by 13 ft. and 6½ ft. high, in which temperature, humidity and illumination can be easily controlled.

A routine method for rearing larvae is described. The most satisfactory of all the foods tested was fine crumbs of dried bread. The rearing pans contain rainwater over a substratum of sieved mud and are kept in a room, heated in winter, in which a roof of "vimlite" (wire screening filled with a cellophane-like material) admits direct sunlight for part of the day. As many as 3,000 Anophelines a day have been reared with the labour of one man. A description is also given of a large water bath, of the type designed by Boyd [*cf.* **21** 36], which is considered essential in experiments with larvae for controlling the temperature in the pans in which they are reared. In outlining the scope of the field work, the authors describe a method for measuring larval densities in which a galvanised iron cylinder, 0·1 square metre in cross section, is thrust quickly into the soil at the bottom of shallow breeding places, the water enclosed is dipped out into a pail, the algae and floating vegetation are washed and discarded, and the larvae are then picked out from the pail and recorded [*cf.* **27** 233].

Roubaud (E.). **Les équilibres biologiques dans l'étiologie du paludisme.**—*Acta Conv. ter. trop. Malar. Morb.* **2** pp. 130–141, 15 refs. Amsterdam, 1938. [Recd. 1939.]

The natural variations in malaria incidence that occur in a given region are the result of a conflict between factors favourable or unfavourable to the cycle of the malaria parasite. These factors may act through man or mosquito, and the author gives a number of examples of the ways in which the mosquito may be affected, in order to emphasise the complexity of the problem.

Garnham (P. C. C.). **Epidemiology of *Anopheles funestus* Malaria with special Reference to Tergal Plate Varieties and Maxillary Indices.**—*Acta Conv. ter. trop. Malar. Morb.* **2** pp. 161–177, 9 figs., 9 refs. Amsterdam, 1938. [Recd. 1939.]

In Kenya, it has been observed that an increase in the abundance of *Anopheles funestus*, Giles, does not apparently give rise to, or prevent the decline of, epidemics of malaria [*cf.* *R.A.E.*, B **17** 249] In a native village, the proportions of *A. funestus* and *A. gambiae*, Giles, found in a hut used exclusively for housing calves at night were 37 and 63 per cent., respectively, whereas in the other huts they were 77 and 23 per cent. The percentages found infected in these two sites were 5 and 2, and 5·6 and 4, respectively. *A. funestus* enters houses between 2 a.m. and dawn [*cf. loc. cit.*]. Characteristic breeding places of the type form of this species are the overgrown edges of slowly moving streams and papyrus swamps, both comparatively shady situations, but in Kisumu, larvae are found in large numbers in widespread stretches of waterlogged ground exposed to bright sunlight. Of nearly 20,000 females examined for sporozoites at Kisumu in 1932–37, 3 per cent. were positive ; the infection rate in *A. gambiae* was 4 per cent. Records of monthly infectivity rates in *A. funestus* for the years 1936 and 1937, when 500–1,000 examples per month were examined, indicate that they are highest during the dry months ; this may possibly be explained by the smaller number of adults emerging and the consequent presence of a greater proportion of older mosquitos in the dry weather.

There are three forms of larva of the typical *A. funestus*, in which the main tergal plates are light, intermediate and dark, respectively. Adults reared from the three forms showed no constant corresponding differentiation, although many of the pupae were coloured like the larvae from which they were obtained. Of 1,377 full-grown larvae collected over a period of 18 months, 62, 20 and 18 per cent. belonged to the light, intermediate and dark forms, respectively. The nature of the breeding places did not seem to influence the form, but seasonal changes were apparently concerned, since the relative percentages of the light, intermediate and dark forms in the wet season were 15, 44 and 41, whereas in the dry season they were 80, 17 and 3. The same breeding place produced dark-plate larvae in the rains and light-plate ones in the dry weather following. Dissections of the reared females showed that the maxillary indices of the three forms were practically identical (about 10·9). The maxillary index of 43 females of *A. rivulorum* var. *garnhamellus*, Evans & Leeson, reared from full-grown larvae was, however, 14, a fact confirming the improbability that this species acts as a vector. Most of the skins of fourth-instar larvae

reared from eggs laid by females shown by dissection after oviposition to be infected were of the light-plate form, but some intermediate- and dark-plate forms were found, particularly in the rainy seasons. It is concluded that all three forms are vectors of malaria. The maxillary indices of naturally infected and uninfected adults of *A. funestus* showed no significant difference, the figures being 11·2 and 11·4, respectively.

It seems probable that the explanation of the anomalies mentioned lies not in differences in the forms of the vector, but in the fact that a large number of cases of quartan malaria occur, especially among children (of whom 75 per cent. are infected), but that this type produces a mild disease, and since the cases rarely undergo treatment, they are not included in the malaria records. Evidence exists that *A. funestus* is a specialised vector of *Plasmodium malariae*, and future investigations may show that the sporozoite infections common in this Anopheline in the dry months of the year are due to this species of parasite.

Mollow (W.). **Ueber Malaria in Bulgarien.** [Malaria in Bulgaria.]—*Acta Conv. ter. Malar. Morb.* **2** pp. 240–249, 1 map, 5 diagr. Amsterdam, 1938. [Recd. 1939.]

An account is given of the organisation for malaria control in Bulgaria, together with notes on the local distribution and history of the disease. Of the Anophelines that have been observed, the chief vector is *Anopheles maculipennis*, Mg., which is represented by races *maculipennis* (*typicus*), *melanoon*, Hackett, *messeae*, Flni., *atroparvus*, van Thiel, *labranchiae*, Flni., and *sacharovi*, Favr (*elutus*, Edw.). *A. superpictus*, Grassi, also acts as a vector [*cf. R.A.E.*, B **17** 219], but *A. claviger*, Mg. (*bifurcatus*, auct.) and *A. hyrcanus* var. *pseudopictus*, Grassi, are unimportant. The last-named occurs chiefly in Macedonia, but adults have not been observed to enter dwellings.

Arar (Asim) & Atamanoğlu (Şerafettin). **La lutte anti-paludéenne en Turquie.**—*Acta Conv. ter. trop. Malar. Morb.* **2** pp. 253–261. Amsterdam, 1938. [Recd. 1939.]

A brief account is given of the work that has been carried out and the results that have been obtained in the campaign against malaria in Turkey since a report made in 1930 [*R.A.E.*, B **20** 74]. There has been no fundamental alteration in the laws or regulations governing the campaign or in its organisation. The number of zones now covered has been increased to 16, and these include the malarious parts of 31 Departments out of 62. The part of the report dealing with the anti-mosquito measures includes a list giving the numbers of mosquitos and of each species of *Anopheles* caught in trains arriving at Ankara in July and August 1938, which indicates the importance of destroying introduced mosquitos in a locality where measures for malaria control are in force. The measures against Anophelines are similar to those already advocated [*cf.* **20** 74; **23** 8], except that the proportion of Paris green used in the dusting mixture against larvae is stated to be 2 per cent. [*cf.* **19** 181]. The abolition of stagnant water has to be carried out by the local population where it does not entail more than 5 days labour in a year. The length of the drainage canals dug in each year from 1927 to 1937 is shown in a table, which also gives the area

of the ground drained in each year since 1925. No species have been added to the list of Anophelines taken in Turkey [**19** 181], but studies on *Anopheles maculipennis*, Mg., carried out by M. Sabit Akalin in the west, north-east and centre of the Anatolian peninsula during 1934–36 have shown that the typical race and race *messeae*, Flni., are widely distributed and that race *melanoon*, Hackett, is rare. Race *labranchiae*, Flni., was not observed, but several specimens that may belong to race *atroparvus*, van Thiel, were found. The spleen and parasite rates according to age groups and the percentages of the different malaria parasites in the positive blood tests from 1930 to the end of 1937 in 14 of the zones covered by the campaign are shown in tables.

LEWIS (D. J.). **The seasonal and geographical Distribution of** *Anopheles maculipennis* **in Albania.**—*Riv. Malariol.* **18** (1) pt. 4 pp. 237–248, 2 pls., 5 diagr., 9 refs. Rome, 1939. (With a Summary in Italian.)

In addition to *sacharovi*, Favr, which he regards as a distinct species, the races of *Anopheles maculipennis*, Mg., that were observed by the author in Albania in 1934 were *maculipennis* (*typicus*), *subalpinus*, Hackett & Lewis, and *messeae*, Flni. In summer, the eggs of these three races agreed with those found in other countries and hardly any doubtful forms were observed, but in spring and autumn many eggs could not be identified with certainty. There were also seasonal changes in the relative numbers of the races and slight changes in the egg pattern of each. To determine whether temperature had any effect on egg pattern, females that had oviposited were kept at a different temperature until they oviposited again. In several cases, the eggs in the second batch varied from those in the first ; raised temperatures were followed by the laying of paler eggs by *messeae* and *subalpinus*, and lower temperatures by darker eggs (*subalpinus* and *typicus*). This effect of temperature explains the difficulty of identifying eggs in the cold weather of early spring and late autumn. Collections of eggs made in summer indicate that *typicus* and *subalpinus* are widespread in Albania, while *messeae* occurs only in the Korca district.

The breeding places and mode of hibernation of *messeae* and *typicus* are characteristic, and *subalpinus* behaves much like *messeae*. In autumn, *sacharovi* and the other three races leave wattle stables and occupy stone buildings, and *typicus* often enters hollow trees. A graph is given showing the dates at which the adults enter and leave their winter quarters. Race *sacharovi* breeds chiefly in brackish water and is seldom found far from the coast. In Albania, it hibernates less completely than the other races ; it enters stone buildings about a month later (about 20th October) and also develops fat later. If transmission of malaria occurs during winter or early spring, this incomplete hibernation may render *sacharovi* an efficient vector then. It also tends to be commoner in winter than might be expected, since it reaches its highest numbers in relation to those of the other races at the end of summer. Adults of *typicus* showed a marked preference for stone stables to wattle ones as resting places.

The geographical and seasonal distribution of the races are described, and the numbers of egg batches of each race obtained from females collected near breeding places of different types are recorded. To determine the types of water selected by the females for oviposition,

eggs of *subalpinus*, *messeae* and *typicus* were collected in shallow water containing plants at the edge of Lake Malik, in which all three races bred, and in streams and pools in the surrounding plain. The results showed that *typicus* laid eggs in many types of water, whereas *subalpinus* and *messeae* oviposited chiefly in marsh water. The influence of temperature in this selection is doubtful, but appears to be unimportant since the minimum night temperature of purely *typicus* breeding places, although lower than that of the marsh, was variable, and the difference was sometimes very slight. Observations in which the variations in prevalence of the adults in summer were compared with changes in the temperature of the water at the edge of the lake indicated that a high water temperature or some other condition due to the combination of factors that also leads to a rise in temperature is more favourable to *subalpinus* than to *typicus*.

CORRADETTI (A.). **Ricerche sulla malaria nella Dancalia meridionale.** [Research on Malaria in southern Dancalia.]—*Riv. Malariol.* **18** pt. 4 pp. 249–255, 2 pls., 1 fldg map. Rome, 1939. (With Summaries in German and English.)

An account is given of investigations in southern Dancalia (Abyssinia) in 1938–39 on the susceptibility of native and other races to malaria. The Anophelines observed were *Anopheles gambiae*, Giles, *A. pharoensis*, Theo., *A. pretoriensis*, Theo., and *A. dancalicus*, Corradetti [*cf. R.A.E.*, B **28** 62], and of these *A. gambiae* is the principal vector. The disease occurs throughout the year on the banks of permanent rivers, whereas in the foothills it is widespread in the rainy season when the local rains are augmented by water from the high plateau, so that floods occur and Anopheline breeding places are numerous. In the plains it is strictly dependent on the local rains.

[RAKHMANOVA (P. I.).] **Рахманова (П. И.). Fréquence des captures des anophèles adultes en but de contrôle de l'efficacité de la lutte antilarvaire.** [*In Russian.*]—*Med. Parasitol.* **8** no. 4 pp. 64–70, 7 graphs. Moscow, 1939.

When adult Anophelines are collected in day-time shelters to ascertain the effect of control measures against the larvae [*cf. R.A.E.*, B **24** 262], it is necessary to determine at what intervals the collections should be made. The authors suggests that, if the state of blood digestion of the females is ascertained, an accurate estimate of the fluctuations in their emergence from the breeding places can be obtained by collecting them at intervals equal to the average period they require for blood digestion in the locality. This period is about 5 days in central Russia, where the mean temperature in day-time shelters is approximately 20°C. [68°F.], and 2 days in southern Russia, where this temperature is 25–30°C. [77–86°F.]. This suggestion was confirmed by observations on the seasonal fluctuations of the adults of *Anopheles maculipennis*, Mg., in day-time shelters in villages, made in 1935 in central Russia, and in 1938 on the northern slopes of the Caucasus mountains. When Paris green is applied against the larvae, however, a 5-day interval may involve an undesirable delay in ascertaining its effect, which becomes evident in a very short period.

[Plyater-Plokhotzkaya (V. N.).] **Плятер-Плохоцкая (В. Н.). Quelques observations sur le comportement des femelles de l'*Anopheles hyrcanus* Pall. dans la région d'Ussuri.** [*In Russian.*]—*Med. Parasitol.* **8** no. 4 pp. 71–74, 6 refs. Moscow, 1939. (With a Summary in French.)

The only species of *Anopheles* in the western low-lying part of the Ussuri region (Russian Far East) is *A. hyrcanus*, Pall. [*cf. R.A.E.*, B **25** 145]. Observations in 1936 showed that the females enter inhabited houses and animal quarters soon after sunset to feed, but leave them again in the morning [*cf.* **15** 181]. Those that were found resting in buildings in the day-time occurred there only because they were not able to make their way out. The females entered buildings of stone, wood or clay, but preferred animal quarters to dwellings. It was shown by catching them in traps that all those that entered buildings were ready to feed, and most of those that abandoned them were freshly engorged, only a few being in the last stages of blood digestion or starved. In the open, they were abundant in the day-time in meadows and rice-fields, especially in places sheltered from the wind; they rarely attacked man during the day, but readily did so in the evening.

[Lazuk (A. D.) & Utenkov (I. N.).]. **Лазук (А. Д.) и Утенков (И. Н.). Sur le développement des larves d'*Anopheles maculipennis* dans les canaux à des vitesses diverses du courant d'eau.** [*In Russian.*]—*Med. Parasitol.* **8** no. 4 pp. 75–79. Moscow, 1939.

An account is given of observations carried out in 1937 in the Western Province of Russia on the rapidity of the currents and the abundance of the larvae and pupae of *Anopheles maculipennis*, Mg., in sections of drainage ditches in a marshy area. The results indicate that few if any larvae can maintain themselves in a ditch that has smooth sides and is in good repair if the current flows at a rate of 2–3 ins. per second. If, however, the ditch is lined with turf or contains aquatic vegetation, the larvae can resist a current of nearly 1 ft. per second. The resistance of the larvae increases with their age.

Boyd (M. F.). **On the Susceptibility of *Anopheles quadrimaculatus* to *Plasmodium vivax* after prolonged Insectary Cultivation.**—*Amer. J. trop. Med.* **19** no. 6 pp. 593–594. Baltimore, Md., 1939.

Batches of *Anopheles quadrimaculatus*, Say, from a strain that had been reared in the laboratory for at least seven years without the addition of any new stock and had probably, therefore, passed through at least 84 generations since the colony was started were fed on three patients infected with a particular strain of *Plasmodium vivax* at the same time as batches of females of the same species caught in nature about half a mile from the spot from which the progenitors of the colony had been obtained. Comparatively little difference in susceptibility was observed, and what there was suggested that the laboratory-bred examples may be slightly more susceptible.

Earle (W. C.). **The Epidemiology of Malaria with Special Reference to Puerto Rico.**—*Puerto Rico J. publ. Hlth* **15** no. 1 pp. 3–27, 4 charts, 9 refs. Menasha, Wis., 1939. (With translation in Spanish pp. 28–43.]

In the course of this paper, the author gives a table showing the average monthly catches in five localities in Porto Rico of *Anopheles albimanus*, Wied., the principal, if not the only, vector of malaria there [*cf. R.A.E.*, B **18** 231]. In four of them, the peak was reached in November or December, when the incidence of malaria infections also reaches its maximum. In San Germán, however, where malaria often reaches its maximum incidence in February, the mosquito was most abundant in January, during the dry season, when conditions are more favourable for its breeding, as the river and its tributaries are repeatedly flooded during the rainy season from August to November.

Gebert (S.). **A small Apparatus for the Experimental Infection of Adult Mosquitoes and their Subsequent Breeding.**—*Trans. R. Soc. trop. Med. Hyg.* **33** no. 3 pp. 353–356, 1 fig. London, 1939.

After briefly reviewing the techniques that have been used to maintain humidity in tubes or cages in which mosquitos are to be kept alive after an infecting blood meal, the author describes a device that is easy to make, requires little attention, and maintains the necessary humidity even in tropical countries during the dry season. The cork of an ordinary corked specimen tube (a convenient size is 3 inches by 1 inch in diameter) is cut in two horizontally, and two V-shaped notches are cut in opposite sides of the lower half, which is then pushed down inside the tube until it is about $\frac{3}{4}$ inch from the bottom. A mosquito is placed in the tube, and the opening is covered with a piece of mosquito netting tied round the neck. After the mosquito has been fed by inverting the tube on the infected person's arm, the tube is held in an inclined position with one of the notches in the lowest position. Water is forced through the netting by means of an ordinary pipette and flows down the side of the tube through the notch into the bottom, the displaced air escaping through the upper notch. The tube is then left standing with a piece of cotton-wool saturated with water on the netting. When it is no longer necessary to feed the mosquito on blood, a few drops of honey smeared under the piece of cotton-wool after it has been wetted will provide sufficient food. All that is required to maintain the apparatus is to saturate the cotton-wool every afternoon and supply honey every 4–5 days. The cotton-wool need not always be kept moist because, once the mosquito has fed during the night, it will not require another meal for at least 24 hours. Moreover, alcoholic fermentation sets in if the cotton-wool is kept continuously moist, and this is detrimental to the mosquito and often causes its death. With this method, the evaporating water saturates all the air in the tube instead of only the upper layers. One charge of water will last 8–10 days according to temperature. Mosquitos have been kept alive for as long as 73 days in this manner.

Liu (C. Y.). **The Fleas of China. Order Siphonaptera.**—*Philipp. J. Sci.* **70** no. 1 pp. 1–122, 132 figs., 128 refs. Manila, 1939.

This paper on the fleas of China [*cf. R.A.E.*, B **25** 72] contains a description of the general characters on which classification is based,

a table giving the names of authors who have described Chinese fleas, with the dates of the descriptions, a list of the 75 species showing the collections in which the types are deposited, keys to the families, subfamilies, genera, subgenera and species, descriptions of the salient characters of each species, and a table showing the hosts of the fleas and the parts of China in which they were taken. One new genus and two new species are described.

ONO (Z.). **On** *Ctenocephalides musculi* **Sugimoto (Siphonaptera, Pulicidae).** [*In Japanese.*]—*Mushi* **12** no. 2 pp. 104–106. Fukuoka, 1939.

It is concluded from a comparison of characters that *Ctenocephalides musculi*, Sugimoto, which was described from rats in Formosa, is a synonym of *C. felis*, Bch.

AFRIDI (M. K.), JASWANT SINGH & HAWANT SINGH. **Food Preferences of Anopheles Mosquitoes in the Delhi Urban Area.**—*J. Malar. Inst. India* **2** no. 3 pp. 219–228, 9 refs. Calcutta, 1939.

The ease with which precipitin tests can be carried out with dried sera made it possible to undertake a study of the food-preferences of Anophelines from different parts of India, and in this paper are given the results of such an investigation carried out on Anophelines collected on alternate days between 7 and 9 a.m. in cattle-sheds and human habitations in and around Delhi during the malaria seasons of 1937 and 1938. Up to the first week in October, the inhabitants slept out-of-doors in close proximity to their cattle, which were frequently tethered in the same courtyard. The greater part of the population used no means of protection against mosquito bites, and until the end of September the weather was not cold enough to necessitate the use of a sheet or blanket. The proportion of mosquitos taken in cattle-sheds was higher than that caught in dwellings, even when both were situated in the same courtyard. The blood from the stomach of each mosquito was tested against antisera of man and several domestic animals; the results are shown in tables. Positive reactions were obtained for 5,026 females of *Anopheles culicifacies*, Giles, 360 of *A. stephensi*, List., 39 of *A. annularis*, Wulp, and 1,824 of *A. subpictus*, Grassi, and 83, 5, 0 and 0, respectively, had fed on man. The numbers of *A. annularis* were too small to permit of any conclusions regarding its food-preferences, and although no human blood was found in *A. subpicius*, further tests are considered necessary before a final opinion on its feeding habits can be given. The great majority of all the Anophelines had fed on cattle, and the percentage of specimens of *A. culicifacies* positive for human blood varied inversely with the ratio of cattle to man. Specimens containing human blood were, however, at least twice as numerous among mosquitos from cattle-sheds and from combined dwellings and cattle-sheds as among those from separate dwellings.

RUSSELL (P. F.) & KNIPE (F. W.). **Malaria Control by Spray-killing Adult Mosquitoes. First Season's Results.**—*J. Malar. Inst. India* **2** no. 3 pp. 229–237, 1 pl., 4 refs. Calcutta, 1939.

To test the effectiveness as a measure against malaria in rural areas of spraying huts and cattle-sheds to destroy mosquitos, the experiment

described was undertaken in 1938 in a village in southern India where previous work had shown *Anopheles culicifacies*, Giles, to be the only vector [*R.A.E.*, B **27** 44]. Most of the structures were poorly thatched and had mud walls with partly open sides, and none could be closed during spraying. All buildings were sprayed at least once a week with a mixture of 19 parts kerosene and 1 part of a commercial extract of pyrethrum (Pyrocide 20). No spraying apparatus tried during the experiment atomised the spray completely, but it is stated in a footnote that a De Vilbiss paint sprayer has since been found to be satisfactory when the air pressures used are more than 15 lb. per square inch. The costs of the experiment are given in some detail. The results are compared with data from an adjacent village that was similar in many respects. Larval surveys showed that Anopheline breeding continued throughout the experiment in both villages at a fairly high rate for the area, but adult Anopheline surveys showed that the numbers were lower in the sprayed village throughout the period of the experiment (June to December), although they had been higher during the preceding five months. However, they also showed that *A. culicifacies* was present in moderate numbers throughout the experiment. On the other hand, the spleen rates in the treated and untreated villages were 67·8 and 54·5 per cent. in November 1937 and 24·0 and 61·0 per cent. in November 1938, and the corresponding parasite rates were 57·1 and 45·5 per cent. in November 1937 and 11·5 and 52·0 per cent. in November 1938. Moreover, the size of spleens also decreased markedly in the treated village, whereas it increased in the untreated one. It is concluded that the transmission of malaria was prevented to a marked extent, but that the cost of the measure, although it was not excessive, was greater than a village could be expected to pay.

ROY (D. N.). **The Importance of *A. varuna* Iyengar as a Carrier of Malaria in Bally (Calcutta).**—*J. Malar. Inst. India* **2** no. 3 pp. 239–242, 1 chart, 7 refs. Calcutta, 1939.

In an Anopheline survey carried out over a period of a year from August 1937 in a mill area about half a square mile in extent near Calcutta, 4,095 adults belonging to 11 species and 39,249 larvae belonging to 9 species were collected. Dissections were made of 1,925 females including 1,100 of *Anopheles annularis*, Wulp, 332 of *A. subpictus*, Grassi, 220 of *A. hyrcanus*, Pall., 113 of *A. varuna*, Iyen., and smaller numbers of the other 7 species, but the only malaria infections found were in *A. varuna*, 4 of which showed sporozoites, 2 in December 1937 and 2 in January 1938. It is concluded that this species is the only vector of importance, although no correlation could be found between the incidence of malaria and the intensity of breeding; fever cases seemed to occur uniformly throughout the year, whereas the larvae of *A. varuna* were definitely more abundant in November than during the other months. Although *A. sundaicus*, Rdnw., was found breeding in small numbers, it is not believed to be of importance in transmission.

ROY (D. N.) & MAJUMDAR (S. P.). **On Mating and Egg Formation in *Culex fatigans* Wied.**—*J. Malar. Inst. India* **2** no. 3 pp. 243–251, 1 pl., 12 refs. Calcutta, 1939.

Observations on the pairing and oviposition of *Culex fatigans*, Wied., were undertaken with a view to determining whether a factor other

than the presence of spermatozoa in the spermathecae and a blood meal were necessary for the formation of eggs, since it has been suggested that such a factor is necessary in *C. pipiens*, L. [*R.A.E.*, B **19** 106]. The mosquitos used were all bred from larvae taken in nature, and man was the only source of blood meals. Pairing took place in both large cages (16 by 12 by 12 inches) and small ones (8 by 6 by 6 inches). Females in captivity were reluctant to feed on man until 3 or 4 days after emergence, even when they had previously been starved; none fed in the first 24 hours after emergence. Females reared without an opportunity for pairing and fed on raisins and water up to the time of the blood meal laid eggs normally, but the eggs did not hatch. Mature eggs were formed in virgin females given nothing but water before and after the blood meal, so that neither the absence of sugar nor the fact that they were unfertilised prevented egg-formation, and no evidence for the need of a third factor was obtained [*cf. loc. cit.*]. When males and females were kept in the same cage for 24 hours and then separated, spermatozoa were present in very large numbers even after 6 weeks in the spermathecae of females that had not been allowed to feed on blood and in which ovulation had consequently not occurred. This proves that if the spermatozoa are not used up in fertilising eggs, they are not periodically discharged, but remain in the spermathecae throughout the life of the mosquito. After blood meals, all the eggs of the first two batches and half of those of a third were fertilised; it seems probable that the remainder were not fertilised on account of the paucity of spermatozoa. A detailed account is given of the development of the ovum and of the micropylar apparatus. The eggs reached maturity in about 72 hours, and as the first blood meal is taken after 24 hours, at least 96 hours must elapse after emergence before oviposition takes place. Oviposition does not necessarily occur immediately after maturation of the eggs. Eggs measured after they were laid were slightly larger than mature eggs within the mosquito.

Russell (P. F.) & Jacob (V. P.). **Some Experiments with a Cheap Method of Treating Casuarina-pits with Paris Green to control Anopheles Breeding.**—*J. Malar. Inst. India* **2** no. 3 pp. 261–271, 2 pls., 4 refs. Calcutta, 1939. **Some Experiments in the use of Fish to control Anopheles Breeding in Casuarina-pits.**—*T.c.* pp. 273–291, 3 pls., 5 refs. **Some Experiments in the Naturalistic Control of Anopheles Breeding in Casuarina-pits.**—*T.c.* pp. 293–313, 3 pls., 5 refs.

An account is given of investigations undertaken with a view to discovering suitable measures for the control of Anopheline larvae in a sandy area north of Madras City where malaria, which is hyperendemic, is almost entirely due to the breeding of *Anopheles culicifacies*, Giles, in wells or pits needed for the cultivation of *Casuarina equisetifolia* [*cf. R.A.E.*, B **28** 2]. Since the livelihood of many persons depends on this crop and the population is poor, the wells cannot be filled in and the measures must be cheap. The method tested in the experiments described in the first paper consists in stirring 1·5 cc. Paris green with a small stick into about 150 cc. sand collected in a small dipper from the side of the pit to be treated and distributing the mixture round the edges and over the surface of the water. The labourer carries "cartridge" belts holding 50 small stoppered vials,

each of which contains 1·5 cc. Paris green, and the dipper, which he fills about three-quarters full of sand. The time required to treat each pit is not more than 2–3 minutes, and one man can easily treat 100 pits a day. When the sand was wet after rain, better distribution was obtained by holding the dipper under the water while the mixture was being shaken out of it Tests indicated that 6 days was the most satisfactory interval between treatments. The method is not effective against the larvae of *Culex* or against the eggs or pupae of Anophelines, but certainly controls, if it does not actually eradicate, the breeding of the vector. Since *A. culicifacies* is normally a weak vector in this area, showing a sporozoite rate of only 0·1 per cent., the authors believe that the method, which is cheap enough to be practised as a permanent routine measure, would control malaria even if it did not destroy all the larvae.

The experiments on larvivorous fish described in the second paper indicate that in the sandy casuarina pits, in which vegetation is scanty, good control of the larvae might be obtained by using *Gambusia affinis*. It would, however, be necessary to have a suitable nursery to provide a constant supply of fish to replace those lost in various ways, and to employ a "fish patrol" to see that all pits were adequately stocked and to remove occasional patches of vegetation. The cost of such a method is discussed, and it is again concluded that although breeding is not completely eradicated, the method is sufficiently cheap and effective to be applied as a routine measure. Experiments were also carried out with two local species of fish, but neither was as effective as *Gambusia* and it seemed unlikely that they could be rendered more efficient by artificial means.

In the third paper are given the results of experiments with various other cheap methods of control, none of which is recommended since they were not so effective as the two already described. They comprised the pollution of water in the breeding places by filling them with vegetation, jaggery or manure, agitating the surface of the water, shading it with mats, and attempting to cover it completely by introducing floating plants.

[Tupaich (M. T.).] **Тупајић (М. Т.). The Problem of effective Protection of Cattle from Invasions by the Golubatz Fly.** [*In Serbian.*]—*Arkh. Min. Pol'oprivr.* **6** no. 16 pp. 89–102, 16 refs. Belgrade, 1939.

Work done in Jugoslavia on *Danubiosimulium columbaczense*, Schönb. [*cf. R.A.E.*, B **24** 276; **27** 85, etc.] is reviewed in detail. The control measures commonly practised to protect domestic animals from it are similar to those recommended in Rumania [**28** 70]. A programme for the organisation of its control is outlined [**26** 34]; it includes the establishment of a laboratory in the centre in which the fly breeds [*cf.* **27** 85] for an exhaustive study of its bionomics and of all the factors that could be made use of to check outbreaks.

Clapham (P. A.). **On Flies as Intermediate Hosts of** *Syngamus trachea.* —*J. Helminth.* **17** no. 2 pp. 61–64, 7 refs. London, 1939.

The author describes experiments which show that flies may act as intermediate hosts of *Syngamus trachea*, the Nematode causing gapes in poultry and other birds. It can also be transmitted directly or through earthworms, slugs or snails. Larvae of *Musca domestica*, L., and

Lucilia sericata, Mg., were kept on meat on which eggs of *S. trachea* obtained from fowl faeces or earthworms had been spread, and some of them were reared to the adult stage. Dissection of samples showed that all of 12 maggots and 10 of 12 flies were infected, each with a single larva. The vitality of the maggots did not appear to be impaired by the presence of the larva, but the infected adults tended to be sluggish and in nature would be an easy prey to birds. Gapes developed in all of 6 chicks each fed on 20 maggots and in 5 of 6 chicks each fed on 20 reared adults.

PAPERS NOTICED BY TITLE ONLY.

ONO (Z.). **Studies on Manchurian Anoplura. 1. Morphological Notes on** *Polyplax spinulosa* **(Burm.) from Manchoukuo.** [*In Japanese.*]—*Mushi* **12** no. 2 pp. 107–111, 2 pls., 1 fig., 5 refs. Fukuoka, Japan, 1939.

KOHLS (G. M.). **Siphonaptera : Notes on Synonymy of North American Species of the Genus** *Hoplopsyllus* **Baker.**—*Publ. Hlth Rep.* **54** no. 45 pp. 2019–2020. Washington, D.C., 1939.

JELLISON (W. L.) & KOHLS (G. M.). **Siphonaptera : A List of Alaskan Fleas.**—*Publ. Hlth Rep.* **54** no. 45 pp. 2020–2023, 3 refs. Washington, D.C., 1939.

[MIRONOV (V. S.).] **Миронов (В. С.). Les moustiques—vecteurs des virus filtrants** [a review from the literature]. [*In Russian.*]—*Med. Parasitol.* **8** no. 4 pp. 80–87, 1 ref. Moscow, 1939.

RUSSELL (P. F.) & HACKETT (L. W.). **A new Classification of Mosquito Control Measures.**—*Acta Conv. ter. trop. Malar. Morb.* **2** pp. 96–99, 1 ref. Amsterdam, 1938. [Recd. 1939.]

BATES (M.). **Variation in the antepalmate Hairs of Larvae of the** *Anopheles maculipennis* **Complex.**—*Riv. Malariol.* **18** (1) pt. 5 pp. 299–312, 14 refs. Rome, 1939. (With a Summary in Italian.)

VAN THIEL (P. H.) (in collaboration with J. REUTER, J. SAUTET & L. BEVERE). **On Zoophilism and Anthropophilism of** *Anopheles* **Biotopes and Species.**—*Acta leidensia* **14** pp. 240–276, 3 figs., 1 pl., 28 refs. Leiden, 1939. (With a Summary in French.) [See *R.A.E.*, B **28** 10.]

CHRISTOPHERS (Sir S. R.). **Malaria in War.**—*Trans. R. Soc. trop. Med. Hyg.* **33** no. 3 pp. 277–292, 1 fig., 3 maps, 8 refs. London, 1939.

BOSHELL-MANRIQUE (J.). **A new Species of** *Aëdes* [*A.* (*Finlaya*) *scutellalbum*, sp. n.] **from Colombia (Dipt. Culicidae).**—*Rev. Ent.* **10** pt. 2 pp. 309–312, 8 figs. Rio de Janeiro, 1939.

JENKINS (C. F. H.). **The Sheep Blow-fly Problem** [a popular version of the results of recent research in Australia].—*J. Dep. Agric. W. Aust.* (2) **16** no. 3 pp. 292–297, 15 refs. Perth, 1939. [*Cf. R.A.E.*, B **25** 78; **26** 81.]

SENIOR WHITE (R.), AUBERTIN (D.) & SMART (J.). **Family Calliphoridae.**—*Fauna Brit. India, Dipt.* **6** xiii + 288 pp., 1 map, 152 figs. London, Taylor & Francis, 1940. Price 18*s*.

ŌMORI (N.). **Experimental Studies on the Cohabitation and Crossing of two Species of Bed-bug,** *Cimex lectularius*, **L. and** *C. hemipterus* **F. (Preliminary Report).**—*Verh. 7. int. Kongr. Ent., Berlin 1938* **2** pp. 895–915, 1 fldg. table, 4 refs. Weimar, 1939.

Cimex hemiptera, F., occurs naturally in Formosa, but *C. lectularius*, L., does not, although it has been bred successfully in Taihoku and many opportunities for its introduction from Japan must occur. In the hope of finding an explanation for this, experiments were undertaken to determine the behaviour of *C. lectularius* when placed in contact with the native species. Three series of experiments were carried out, in which both sexes of both species were kept together, in which females of each species were kept with males of the other species and in which females were kept for alternate periods of three days with males of their own species and with those of the other species. The results show that males of either species paired readily with females of the other, but the resulting eggs were not fertile. Females of *C. lectularius* that had paired with males of *C. hemiptera* or of both species laid only a few eggs and their lives were usually shortened. These effects were more pronounced at higher temperatures and absent at 15°C. [59°F.]. No such effects were observed when females of *C. hemiptera* paired with males of *C. lectularius*.

[VUKASOVIĆ] VOUKASSOVITCH (P.). **Contribution à l'étude biologique de** *Pediculoides ventricosus* **New., acarien parasite.**—*Verh. 7. int. Kongr. Ent., Berlin 1938* **3** pp. 1685–1714, 3 figs., 5 refs. Weimar, 1939.

A detailed account is given of further investigations carried out in the laboratory on the bionomics of *Pediculoides ventricosus*, Newp., which is responsible every year for outbreaks of dermatitis in a district near Mostar, Jugoslavia [*cf. R.A.E.*, B **26** 65]. It was reared on the larvae of various insects. Descriptions are given of the birth of the mature mites and their pairing, of the dispersal of the females and their fixation on the host, and of the effects of this fixation on the host [*cf.* A **14** 564]. The results are also recorded of observations on the length of the period of gestation, on the numbers of adults produced and the length of time over which they appear, on the ratio of the sexes under different conditions, and on unfertilised females, which give rise to males only. Further work is necessary on various points, but the results show great differences between individuals, even those arising from the same female, in respect of size, number of offspring, ratio of sexes in the offspring, and in such points of behaviour as the length of the period of migration before fixation. The differences are more pronounced when conditions are less favourable. Thus, it is only by observations on a large number of examples that average values characteristic of the species can be established.

TURBET (C. R.). **Veterinary Division. Annual Report for 1938.**—*Annu. Bull. divl Reps Dep. Agric. Fiji 1938* pp. 39–47. Suva, 1939.

Haemaphysalis bispinosa, Neum., was found on cattle in Fiji in 1931 [*cf. R.A.E.*, B **19** 177]. Efforts were at first made to eradicate it, but after two years this was found to be impossible. Attempts to

confine it to the Suva side of the Rewa river were apparently successful until 1938, when it was found on the other side, and it was then considered impracticable to continue the application of restrictive measures. Eight years' experience has shown that the number of ticks infesting any one beast is never large, and as no evidence of tick worry [*cf. loc. cit.*] has been observed, its presence in small numbers is not now considered to be of any economic importance.

BILAL (S.). *Ornithodorus lahorensis*, **un vecteur possible de la tularémie.** —*Bull. Soc. Path. exot.* **32** no. 9 pp. 872–874. Paris, 1939.

In laboratory experiments, some of which are briefly summarised, examples of *Ornithodorus lahorensis*, Neum., were fed on a rabbit infected with tularaemia and were subsequently fed on or injected into guineapigs [*cf. R.A.E.*, B **27** 143]. From the results, the author concludes that the tick can transmit the disease by bite even as long as 205 days after the last infecting feed, and that *Bacterium tularense* survives for over 550 days in living ticks and for at least a month in dead ticks kept in a cool dark place. Thus, *O. lahorensis*, which is widely distributed in Turkey, may play an important part in the transmission of tularaemia. Its bites are toxic to man and animals, and it is reported to be responsible for considerable losses among sheep and goats. It lives in crevices in sheep-folds and sometimes invades dwellings and attacks man.

LAVIER (G.) & CALLOT (J.). **Gîtes larvaires de culicidés en eau fortement minéralisée. Présence dans le centre de la France de** *Culex theileri*, **Theob.** (=*C. tipuliformis* **Theob.**).—*Bull. Soc. Path. exot.* **32** no. 9 pp. 876–880, 15 refs. Paris, 1939.

The authors describe a descending series of pools the water in which became increasingly less alkaline the greater the distance from the highly mineralized spring from which they were fed. An analysis of the water at the source is given. In the first pool (a cemented fish pond), in which the pH was 8, larvae of *Anopheles maculipennis*, Mg. (probably race *atroparvus*, van Thiel) were extremely abundant and constituted almost the whole population of mosquito larvae, as was also the case in the second pool (an ornamental pond). In the ditch leading from this pond, they constituted only two-thirds of the population and in the third pool (a small collection of water used as a drinking place for cattle) only about half. Among the other mosquito larvae present were those of *Culex theileri*, Theo. (*tipuliformis*, auct.), which have only once before been recorded from France [*R.A.E.*, B **15** 15].

USINGER (R. L.). **Descriptions of new Triatominae with a Key to Genera (Hemiptera, Reduviidae).**—*Univ. Calif. Publ. Ent.* **7** no. 3 pp. 33–55, 1 pl., 27 refs. Berkeley, Calif., 1939.

The author erects two new genera, describes eight new species and one new subspecies, and gives a key to the genera. He considers *Mestor* (type *megistus*, Burm.) to be a genus distinct from *Panstrongylus* and refers to it *seai*, del Ponte, *geniculatus*, Latr., *rufotuberculatus*, Champ., and *lignarius*, Wlk. On the other hand, he does not consider *Eutriatoma* (type *tibiamaculata*, Pinto [*cf. R.A.E.*, B **14** 169]) to be

distinct from *Triatoma*. Of species included in *Eutriatoma* by Pinto [*cf.* **20** 107], he makes *maxima*, Uhler, the type of a new genus *Dipetalogaster* and considers that *uhleri*, Neiva, is a subspecies of *T. rubida*, Uhl.

Davis (G. E.). **Relapsing Fever : *Ornithodorus hermsi* a Vector in Colorado.**—*Publ. Hlth Rep.* **54** no. 49 pp. 2178–2180, 5 refs. Washington, D.C., 1939.

The earliest known endemic focus of relapsing fever in the United States was in Colorado, and the cases that have been reported from this State since 1915 are briefly reviewed. In the summer of 1937 and in July 1938, an extensive but unsuccessful search was made in some of the localities where cases had occurred for ticks of the genus *Ornithodorus*. In September 1938, however, 51 examples of *O. hermsi*, Wheeler [*cf.* *R.A.E.*, B **27** 131, etc.] were collected from the nest of a chipmunk (*Eutamias* sp.) and from crevices in rotting wood in a stump of a Douglas fir on a hillside at an altitude of approximately 8,800 feet near a cabin in which two cases of relapsing fever had occurred earlier in the season. No spirochaetes were discovered in them, and examination of several chipmunks, the only rodents seen in the locality, showed them to be free from ticks. In June 1939, 213 examples of *O. hermsi* were taken from another decaying Douglas fir stump in the same locality, and some of these ticks and their progeny were proved to harbour spirochaetes. *O. hermsi* had previously been known only from three counties in California and from one locality in Idaho. The author's observations show that its range extends nearly 600 miles eastward to beyond the continental divide and suggest the possibility of its sporadic occurrence in a considerable part of the Rocky Mountain region. The only other record of a spirochaete vector in Colorado is that of a single nymph of *O. parkeri*, Cooley, from a group of 8 prairie dogs (*Cynomys* sp.) collected in August 1938 from a locality in the sage brush desert in north-western Colorado ; no case of relapsing fever has been reported from this part of the State.

Unusual Infestation of a Ship with Black Widow Spiders.—*Publ. Hlth Rep.* **54** no. 50 pp. 2195–2196. Washington, D.C., 1939.

An account is given of an unusual and heavy infestation of a ship at Miami, Florida, by *Latrodectus mactans*, F. Numerous adults and egg sacs were located about the hull frames, in the crew's quarters, on the underside of mess tables and benches, in the motor compartments of electric refrigerators, beneath clothing lockers and in the life-boats on the deck, but no case of spider bite occurred. Two fumigations with hydrocyanic acid gas at the rate of 4 ounces per 1,000 cu. ft. and an exposure of 3 hours were carried out with an interval of 3 weeks. Since several live spiders were present after the second fumigation, rigid inspection will be continued and further fumigation will be undertaken if necessary. A heavy infestation with cockroaches provided an ample food-supply for the spiders, and apparently this and the safe harbourage afforded by the complex type of construction of the ship accounted for the rapid multiplication and heavy infestation.

EAGLESON (C.). **Insect Olfactory Responses. Construction and Use of an Olfactometer for Muscoid Flies, and a Discussion of Interpreting Results.**—*Soap* **15** no. 12 pp. 123, 125, 127, 1 fig., 2 refs. New York, N.Y., 1939.

The following is the author's summary: A U-type olfactometer is described and figured. Flies are imprisoned in a U of adjustable length, one arm of which is perfused with the odour of the attractive or repellent material tested. At regular intervals counts are made of the number of insects resting on the wire-screen septa closing the arms of the U. The formula given for calculation of reactance [a word chosen to designate a scale ranging from +100 to −100, positive values meaning attraction and negative values repulsion] is $R=\frac{100(E-C)}{C}$ where R=reactance, C=control ratio of populations before test, and E=experimental ratio of populations after introduction of the odour.

TRUSLER (R. B.). **Prolonging Toxicity of Pyrethrum Insect Sprays.**—*Soap* **16** no. 1 pp. 115, 117, 119, 6 refs. New York, N.Y., 1940.

Tests were carried out on house-flies [*Musca domestica*, L.] by the Peet-Grady method to determine the relative effects of various anti-oxidants on the keeping quality of a pyrethrum extract in a highly refined base when it was kept for 36 months at 32°C. [89·6°F.] in bottles with 25 per cent. air space. All were effective to a greater or less extent when compared with the same insecticide without anti-oxidant. With a view to making such tests in a much shorter period, experiments were carried out on similar solutions after they had been kept at a temperature of 70°C. [158°F.] for 1–3 weeks in an endeavour to bring about commensurable changes, but it was found that the temperature was too high, since it promoted changes in the anti-oxidants that do not occur under normal conditions. Further tests are to be undertaken at 50°C. [122°F.].

MOHLER (J. R.). **Report of the Chief of the Bureau of Animal Industry, 19**[38–]**39.** 82 pp. Washington, D.C., U.S. Dep. Agric., 1939.

The progress of the campaign for the eradication of *Boophilus annulatus*, Say, on cattle, horses and mules in the United States led to a reduction of the area under Federal Quarantine to 2 per cent. of its original size [*cf. R.A.E.*, B **27** 145]. The progress that has been made in the eradication of the tick in the four counties in Florida in which legislation passed in 1937 authorised the removal of deer from infested areas has been so satisfactory that eradication may be accomplished within the next year. Authority has now been given for the removal of deer from the two other counties, but there, owing to the dense swamps and the extent of the area involved, eradication may take several years to complete. In the Lower Rio Grande Valley, re-infestation occurred on several occasions as a result of the straying or smuggling of tick-infested animals into Texas from Mexico, and no completely effective barrier to these movements has yet been devised. In Porto Rico and the Virgin Islands, where the tick concerned is *B. a. microplus*, Can. (*australis*, Fuller), it was also necessary to treat sheep, goats and a few deer on infested premises. The western third of Porto Rico, which covers an area of 1,243 square miles, was released from quarantine.

In the course of investigations on anaplasmosis, it was found that the disease was not transmitted to susceptible cattle by any stage of the progeny of females of *Otocentor* (*Dermacentor*) *nitens*, Neum. Further experiments on washes for the control of ox warbles [*cf.* **27** 145] carried out in Colorado on cattle infested with *Hypoderma lineatum*, Vill., showed that those consisting of 12 oz. derris or cubé powder (4–5 per cent. rotenone), 4 oz. white-flaked soap and enough water to make 1 U.S. gal. were very effective in killing the larvae. One treatment may kill all of them, but treatment should be applied every 21–30 days so long as warbles continue to appear in the backs of cattle. To determine the effect of warble infestation on beef production, 16 cattle were kept in a fly-proof enclosure and 18 in an adjoining unscreened enclosure. The experiment lasted for about two years, and the results showed that the exposed animals gained an average of 514 lb., whereas the protected ones gained 550 lb. Further experiments in New Mexico and Texas on the control of grub [*Oestrus ovis*, L.] in the head of sheep showed that the most effective of the various preparations tested was a 3 per cent. solution of a saponated solution of cresol, which was forced into the nasal passages from tanks in which the pressure was maintained at 35–45 lb. Approximately 2 U.S. fl. oz. was used per sheep; 1 U.S. gal. of the concentrated product made sufficient solution to treat about 2,000. The effectiveness of this treatment on range sheep was shown by a comparison of 30 treated with 30 untreated lambs which were slaughtered at intervals for the local market. The untreated lambs had an average of about 22 larvae per animal and the treated ones about 3; it was concluded that the treatment killed about 90 per cent. of the larvae. Experiments in New Mexico with dips containing fused bentonite-sulphur (30 per cent. sulphur and 70 per cent. bentonite) indicated that one dipping would eradicate sheep ticks [*Melophagus ovinus*, L.], but this dip does not eradicate cattle lice and is ineffective against *Hypoderma*.

Since Oribatid mites serve as intermediate hosts of sheep tapeworm (*Moniezia expansa*) [*cf.* **27** 145; **28** 51], studies have been undertaken on their ecology with a view to the development of control measures. The mites were found on pastures throughout the year, but were most abundant from March until September and were especially prevalent in August; they occur on grass and in the soil to a depth of at least two inches. Of 1,373 mites collected in August and of 21 collected in September, 294 and 11, respectively, were infected. Cysticercoids of *M. expansa* obtained from Oribatid mites were fed to four lambs; three became infected and eggs of the tapeworm were found in their faeces in about 40 days.

Of various groups of Lamellicorns subjected to infestation with the larval stages of the thorny-headed worm of swine [*Macracanthorhynchus hirudinaceus*], only grubs of the genus *Lachnosterna* were found to be capable of surviving the infection. The development of the larvae in the grubs is slow, and rather more than 12 weeks is necessary for them to reach the stage that is infective to pigs. The optimum temperature for their development is about 70°F. When the temperature is below 50°F. development ceases, but it is resumed when the temperature rises. This indicates that development in grubs infected in late autumn is probably suspended during the winter and completed in the following spring. The parasites survive the pupation of the grubs and the metamorphosis of the pupae into adults, their development being accelerated during these transformations. The adult beetles apparently continue

to harbour the pre-infective and infective stages of the worms and may therefore constitute a danger to pigs that eat them. Larvae of meal beetles have been found by experiment to be susceptible to infection with the cysticercoids of the poultry tapeworm, *Raillietina cesticillus* [*cf.* **26** 213]. Pupae and adults of these insects infected as larvae were found to harbour the cysticercoids and were capable of infecting fowls to which they were fed. These results indicate the importance of keeping chicks away from areas where feed contaminated with meal beetles is stored and of not feeding them on such feed.

McCulloch (R. N.). **A portable Jetting Race. Details of single-sheep raised Type.**—*Agric. Gaz. N.S.W.* **50** pts. 9–10 pp. 481–484, 516, 532–536, 8 figs. Sydney, 1939.

The second part of the paper consists almost entirely of detailed plans with measurements for the construction of a jetting race for treating sheep against blowflies. In the first part, notes are given on the recent improvements over older types [*cf. R.A.E.*, B **25** 211] embodied in this model, the measurements of the different parts, the materials required, equipment to protect the operator [**27** 265], the use of multi-jet nozzles [*cf.* **26** 160], the preparation of calcium arsenite jetting mixture [*cf.* **24** 39, etc.], and the repeated use of waste jetting mixture [**27** 265].

Keast (J. C.). **Sheep Blowfly Dressings. Zinc Sulphate and Boric Acid Compounds.**—*Agric. Gaz. N.S.W.* **50** pt. 10 pp. 537–538. Sydney, 1939.

After outlining the qualities of an ideal dressing for sheep attacked by blowfly larvae, the author describes a dressing that has given more satisfactory results than many others tested in the blowfly research section of the Trangie Experiment Farm, New South Wales. To prepare it, 10 oz. zinc sulphate is dissolved in 7 pints water, 4 oz. powdered starch is added, and the fluid is gently heated until the starch is dissolved. When the watery jelly formed is cool, 8 oz. carbon tetrachloride is well mixed into it, preferably by forcing it repeatedly through a syringe. A white fluid with the consistency of a thin paste is produced. As the carbon tetrachloride tends to settle out on standing, the dressing must be well shaken before use. Blowfly attack was not severe at Trangie during 1936 and 1937. From August 1936 to August 1937, 104 strikes were dressed and four re-strikes occurred, three of which were on a single sheep. The penetration and wetting power of the dressing were good, and the larvicidal action was excellent, the maggots invariably dying within a few moments of its application. It had a drying effect on the wound, a thin scab being formed that later peeled off and left a soft, dry site. Its repellent properties were fair. Since a slight scalding effect that was probably due to the carbon tetrachloride was occasionally produced on severely struck areas, tests were carried out with a dressing in which the amount of this substance was reduced from 5 per cent. to 3, but, although this dressing proved less irritating, its larvicidal properties were so reduced as to render it unsatisfactory. A dressing prepared in the same way, but in which the zinc sulphate was replaced by boric acid, was not quite so effective, but penetrated the wool satisfactorily and had a good larvicidal action.

Freney (M. R.) & Graham (N. P. H.). **A new Dressing for Fly Struck Sheep.**—*J. Coun. sci. industr. Res. Aust.* **12** no. 4 pp. 311–318, 3 refs. Melbourne, 1939.

Owing to the increase in the price of glycerine, the cost of the dressing of glycerine and boric acid previously recommended in Australia [*cf. R.A.E.*, B **23** 292 ; **24** 133] for use on sheep attacked by blowflies has become prohibitive. A detailed account is given in this paper of investigations carried out to discover another dressing that could be made cheaply but would again incorporate boric acid as the main larvicidal compound. The percentages by weight of the ingredients in the camphor-boracic emulsion (C.B.E. dressing) finally evolved were 4·1 potassium hydroxide, 10·05 boric acid, 13·2 oil of camphor, 2·5 oleic acid and 70·15 water. When tested in the field, this dressing proved to be superior to the di-boric glycerine preparation in its ability to penetrate the wool and on account of its lower viscosity, and was at least equal to it in its larvicidal action and in its healing properties. It is extremely doubtful whether any dressing at present known will protect highly susceptible types of sheep from re-strikes during periods of intense fly activity. To do so, a dressing would have to retain strong repellent properties over long periods of time, to remain adhering to the wool and to retain its larvicidal or ovicidal properties in spite of being continually washed by urine.

Gill (D. A.) & Graham (N. P. H.). **Studies on Fly-strike in Merino Sheep. No. 3.—The Influence of Fly-strike and Conformation on Body-weight and Fleece-weight of Merino Sheep at "Dungalear", New South Wales.**—*J. Coun. sci. industr. Res. Aust.* **12** no. 4 pp. 319–329, 3 figs., 5 refs. Melbourne, 1939.

The following is the authors' summary : Advantage has been taken of the presence at Dungalear Station, Walgett, of a flock comprising A, B and C class sheep [sheep in which the conformation of the breech renders their susceptibility to crutch strike low, intermediate or high (*cf. R.A.E.*, B **26** 6)], half of which had been protected from breech strike by the Mules' operation [*cf.* **27** 197], to study the effects of breech strike on body weight and wool production and the relative merits of A, B and C class sheep as wool producers, under conditions which permitted the masking effect of difference in susceptibility to breech strike to be allowed for.

The adverse effect of breech strike on body weight and wool production depends on the number and severity of the strikes incurred. It was found that the average fly-strike incidence in a flock of this type reduced the fleece production of the whole flock by approximately 5 ounces per sheep. This significant loss, amounting to about £16 per 1,000 sheep when greasy wool is worth 1s. per pound, is due to interference with wool growth and must be added to the many other costs of fly-strike. The extent to which the greater incidence of fly-strike in C and B class sheep can mask their relative merits as wool producers when compared with A class sheep is shown by the fact that unstruck C's produced 11 ounces, and unstruck B's 4 ounces, more greasy wool per head than unstruck A's, but when the normal incidence of fly-strike was taken into consideration the advantage of the C's was reduced to 4 ounces per head while that of the B's was eliminated altogether.

Tenderness of wool was only associated with fly-strike in some of those sheep which had incurred severe strikes; otherwise there appeared to be no connection. The fleeces of the A class sheep tended to be slightly longer and "stronger" than those of the B and C class sheep and were estimated to give slightly higher yield of clean scoured wool.

ROY (D. N.) & SIDDONS (L. B.). **On the Life History and Bionomics of** *Chrysomyia rufifacies* **Macq. (Order Diptera, Family Calliphoridae).**—*Parasitology* **31** no. 4 pp. 442–447, 12 refs. London, 1939.

The following is based on the authors' summary: Observations on the bionomics of *Chrysomyia rufifacies*, Macq., in India are recorded. Protein is essential for the maturation of eggs, which was completed about 5 days after emergence. Pairing is necessary for oviposition, though egg formation can proceed without it. A single pairing is sufficient for the fertilization of at least three batches of eggs. Eggs hatched in 8–12 hours. The average number produced by reared females was 210. Development from egg to adult occupied about $9\frac{1}{2}$ days in summer. Females, whether reared or caught in nature, always produced offspring of one sex only, either all males or all females. This phenomenon is unique or extremely rare among animals in which parthogenesis does not occur.

ROY (D. N.) & SIDDONS (L. B.). **A List of Hymenoptera of Superfamily Chalcidoidea Parasites of Calyptrate Muscoidea.**—*Rec. Indian Mus.* **41** pt. 3 pp. 223–224, 3 refs. Delhi, 1939.

A Pteromalid, *Spalangia* sp., and the Chalcids, *Brachymeria fulvitarsis*, Cameron, *B. argentifrons*, Ashm., and *Dirhinus pachycerus*, Masi, have been bred from various species of *Sarcophaga* in Kurseong and Calcutta. The species of *Spalangia* has also been bred from *Stomoxys calcitrans*, L., *Chrysomyia megacephala*, F., and *Musca domestica vicina*, Macq., *B. fulvitarsis* from *C. megacephala*, and *D. pachycerus* from *C. megacephala* and *Musca inferior*, Stein, all in Calcutta.

HAFIZ (H. A.). **Observations on the Bionomics of the Midge** *Chironomus* (*Limnochironomus*) *tenuiforceps* **(Kieff.) occurring on the Filter-beds of the Calcutta Corporation Water Works at Pulta, near Calcutta (Chironomidae: Diptera).**—*Rec. Indian Mus.* **41** pt. 3 pp. 225–230, 1 fig., 9 refs. Delhi, 1939.

Chironomus (*Limnochironomus*) *tenuiforceps*, Kieff., is by far the most abundant of several species of Chironomids occurring in the slow sand filter-beds in the waterworks of the Calcutta Corporation. Its "mound-shaped" larval and pupal cases, which are found spread almost uniformly over the surface layer of the filter-beds, appear to interfere to some extent with the process of filtration, and investigations were therefore undertaken on its bionomics. The eggs are embedded in pear-shaped gelatinous masses, each containing several hundred, and these are moored to the surface layer of the filter-beds by short stalks. In the laboratory, hatching took place in about 4 days. A study of the larval instars was not possible as larvae could not be kept alive for more than a few days in the laboratory. The pupal period appeared to last 3–4 days and the life-cycle not more than

about 20 days. Notes are given on the morphology of the egg, larva and pupa, and the construction of the tube in which the larva lives and pupates and the habits of the larva and pupa are described. The " cylindrical " larval and pupal tubes of *C.* (*Chironomus*) *barbatitarsis*, Kieff., and *C.* (*Cryptochironomus*) *orissae*, Kieff., also occur on the filter-beds, but they are less numerous and do not completely cover up the surface layer. The removal, in the neighbourhood of the filter-beds, of grass and other weeds among which the newly emerged Chironomids rest during the hot part of the day before pairing and laying eggs has caused some reduction in their numbers.

Buckley (J. J. C.). **On *Culicoides* as a Vector of *Onchocerca gibsoni* (Cleland & Johnston, 1910).**—*J. Helminth.* **16** no. 3 pp. 121–158, 5 pls., 15 figs., 28 refs. London, 1938.

The following is substantially the author's summary : The problem of the vector of *Onchocerca gibsoni*, the cause of " worm nodules " in cattle, was investigated in Kuala Lumpur, Federated Malay States, where the incidence of this parasite is endemic and a high percentage of cattle is infected. The experimental work was carried out with species of *Culicoides* and *Lasiohelea* of which 18, possibly more, species were taken on cattle ; some of them were found to bite in very large numbers daily. The reasons why the work was confined to these genera are discussed ; they include the fact that no species of *Simulium* or *Phlebotomus* were found at Kuala Lumpur. The distribution of the microfilariae of *O. gibsoni* in the skin of live cattle was found to be very irregular, even within small areas of skin. In transverse sections of skin, microfilariae appear to have a maximum concentration just under the epidermis at a depth of 0·05 to 0·2 mm. The insects used were caught on cattle, and males were never taken. Of 1,523 females of *Culicoides pungens*, de Meij., which were dissected soon after a blood meal on an infected animal, 0·52 per cent. were found to have picked up the microfilariae. Of 1,670 females of the same species dissected some days after an infective blood meal, 0·96 per cent. were found to have developing or mature filarial larvae in the thorax or head, and of 3,734 dissected soon after being collected, 0·35 per cent. were found to be naturally infected with filarial larvae in the thorax or head. The difference between these two percentages (the experimental and the natural infection rates) was shown to be statistically significant, and it is concluded that *C. pungens* is an intermediate host of *O. gibsoni*. Females of *C. oxystoma*, Kieff., *C. shortti*, Smith & Swaminath, and *C. orientalis*, Macfie, were also dissected in large numbers and were found to pick up the microfilariae of *O. gibsoni* ; in each of these species the experimental infection rate exceeded the natural infection rate, but the difference was in no case significant. It is concluded, however, from the results obtained and from the morphological similarity of the mature larvae found in these species and those found in *C. pungens* that these species are also intermediate hosts of *O. gibsoni*.

C. peregrinus, Kieff., and *C. buckleyi*, Macfie, are suspected but not proved intermediate hosts. *C. anophelis*, Edw., and *Lasiohelea stimulans*, de Meij., were found to pick up the microfilariae, but only partial development occurred in them. *C. sumatrae*, Macfie, and *C. raripalpis*, Smith, also picked up the microfilariae, but no development was found in them. The remaining species gave negative results.

In view, however, of the very minute percentage of infection that occurs in species of *Culicoides* and the large numbers that must be dissected to obtain positive results, the negative results given by the less common species are not necessarily conclusive.

HOFFMAN (W. A.). *Culicoides filariferus*, **new Species. Intermediate host of an unidentified Filaria from southwestern Mexico.**—*Puerto Rico J. Pub. Hlth trop. Med.* **15** no. 2 pp. 172–174, 3 figs., 5 refs. ; also in Spanish, pp. 175–176. Menasha, Wis., 1939.

A description is given of the female of *Culicoides filariferus*, sp. n., the Ceratopogonid in which Dampf in Mexico found filariae in the sausage stage [*R.A.E.*, B **25** 57]. In view of the fact that the midges were most abundant near stables, the author suggests that these filariae may have been immature forms of a species of *Onchocerca* that attacks equines [*cf.* **22** 59 ; **23** 197] or possibly cattle [*cf.* preceding abstract].

DU TOIT (R.) & SMIT (B.). **The Horn-fly Problem in South Africa.**—*Fmg in S. Afr.* repr. no. 112, 2 pp., 1 fig. Pretoria, 1939.

Lyperosia minuta, Bezzi, the morphology of which is briefly described, is of considerable importance as a pest of domestic animals in South Africa. Although it transmits no disease, its bite is so irritating that cattle lose weight, the milk yield of cows is reduced, sheep suffer from a condition known as " sore head," and the lesions caused by the animals rubbing themselves to relieve the irritation may be attacked by various blowflies or by the screw-worm fly, *Chrysomyia bezziana*, Villen. [*cf. R.A.E.*, B **24** 201] or invaded by bacteria. *L. minuta* has been present in various parts of Africa for many years, but has only recently constituted a menace. It was reported on cattle and sheep in Cape province shortly after 1930 and in Natal in 1936. Investigations showed that during the preceding years it had spread from the south-west to the north-east along the coastal belt. It was also observed that cattle that had been subjected to its attacks for a considerable period had developed a certain degree of tolerance and few lesions due to rubbing were present, whereas in freshly invaded territory the characteristic lesions were present in as many as 60 per cent. of the cattle in some herds. Since 1936, it has spread to various parts of Natal. It is typically a species that frequents low-lying areas of comparatively high rainfall, so that there is little danger of its spreading into Karroo areas. Both very dry and excessively wet seasons are unfavourable, the latter observation being confirmed by the situation in Natal in the summer of 1938–39 when continuous heavy rains were responsible for a low incidence of the fly ; the excess moisture renders the dung unfit for the development of the larvae.

The general practice along the coastal belt is to dip cattle against ticks every 7 days. As the animals enter the dip the flies leave them in a cloud, and hover over the entrance to the dip before alighting on them again in the draining pen. Sprays containing a contact insecticide such as pyrethrum, directed against the clouds of flies, have been very successful in certain parts, and traps through which the cattle walk [*cf.* **26** 248] may be erected over the entrance to the dip

to catch the flies as they leave the animals. Experimental traps have given promising results, but the great reproductive capacity of the fly would render both these methods ineffective in eradicating it if they were applied only at 7-day intervals. Investigations on the treatment of the lesions showed that crude castor oil applied with a swab at intervals of 3–4 days acts as a repellent, prevents further irritation and soothes the raw surface. Chronic lesions that have existed for a year or more have been cured by this means. If the wounds are infested with blowfly larvae, the standard blowfly dressing [*cf.* **20** 37] should be used, but it is advisable to substitute crude castor oil for the cottonseed oil.

Lamborn (W. A. S.). **Annual Report of the Medical Entomologist for 1938.**—*Annu. med. sanit. Rep. Nyasald 1938* pp. 40–48, 3 refs. Zomba, 1939.

During the year, a survey was carried out in the Dowa District of Nyasaland to determine what effect the considerable economic development that has occurred in this area in recent years has had on infestation by the tsetse fly [*Glossina morsitans*, Westw.]. The history of its distribution there is briefly reviewed. Under the schemes of the Empire Cotton Growing Corporation, much of the fly-infested area has been developed for cotton growing, and the survey indicated that the numbers of flies have diminished greatly over the whole area, although a stray individual is occasionally encountered. They seemed to be absent in three of the " primary centres " mentioned by Shircore [*cf. R.A.E.*, B **2** 96], in which settlement has occurred and in which they previously congregated in the late dry season (the time when the survey was undertaken), but were still caught at the rate of 3 or 4 in an hour in the fourth. Nowhere were they present in swarms such as formerly existed in the area. The improvement in the situation is very definite and is being confirmed by the re-introduction of stock. Little game seems to be present in the area. The only recommendation made, except for stressing the need for continuing development, especially in the neighbourhood of the fourth centre, was that the elimination of game should be accelerated by the suspension of the game laws in an area up to the limit of the " good soil," north of which is the newly established game reserve. Another survey was undertaken in the Kusungu District. In former years the Kusungu plain was very bare and supported a number of cattle, but recently there has been considerable regeneration of the forest and, presumably as a result of this or of the movement of game, particularly buffalo, out of the game reserve, the fly has advanced across the plain. Flies were taken in considerable numbers within the reserve and in smaller numbers in several localities on the plain 6 or 7 miles from it. There was also evidence of the existence of game, particularly buffalo, at a still greater distance. The measures recommended include deforestation, particularly in the vicinity of villages where stock is still maintained, the suspension of the game laws over a certain area, and settlement in areas where deforestation is specially needed.

Details are given of laboratory work on the transmission of various pathogenic organisms by insects. Examples of *Musca sorbens*, Wied., were allowed to feed on fresh tubercular sputum. The tubercle bacilli were passed as bacillary, coccoid, and intermediate forms, apparently

unchanged, up to about 15 days after the infecting meal, and in numbers considerably greater than they occurred in the original medium. After about the fifteenth day, coccoid forms only could be found. Similar results were obtained in experiments in which flies were fed on dried sputum, even when it was 79 days old. In further experiments, flies were fed on sputum that had been dried and then kept in a moist atmosphere (in an endeavour to reproduce conditions to which sputum would naturally be subjected as a result of seasonal change). In the last experiment of this series, in which flies were fed on sputum that had been dried for 62 days and then kept moist for another 15 days, their faeces contained coccoid forms only; these forms, which were the only ones present in the original material, were definitely recognisable for 5 days. Only these forms could be distinguished in this sputum 36 days later, though it had been kept in a constantly moist atmosphere. The observation that the coccoid bodies outlast the bacillary ones suggests that they may be immature or resistant forms. It seems certain that if the viability of the organism is not impaired by passage through flies, the latter must play an important part in the dissemination of tuberculosis.

The study of the transmission of leprosy bacilli by the same fly was continued [*cf.* **25** 154], the flies being fed on dried instead of fresh material. A smear of this material showed bacillary forms, mostly massed as globi, in great abundance, with granules among them and a few free coccoid forms. Flies invariably deposited the organisms when feeding after regurgitation, discharging them in their faeces for a period as long as that when they were fed on fresh material [*cf.* **23** 226; **24** 187], even when the material had been kept dry for 167 days. In one experiment, coccoid forms, definitely recognisable by the attachment of a particle of acid-fast material, sometimes filamentous, could be seen in some number on about the twelfth day and could be made out up to about the nineteenth. Ten examples of *Mansonia* (*Mansonioides*) *uniformis*, Theo., were allowed to feed to repletion on a nodule, apparently about to break down, on the arm of a leper. Organisms were found among the stomach contents of all the mosquitos 4 hours later, isolated bacillary forms apparently occurring in greater numbers than in smears from open sores on the same subject, in which globi predominated.

With a view to determining the susceptibility of *Anopheles rhodesiensis*, Theo., to malaria infection, 10 females were dissected 10–13 days after they had fed on a carrier of quartan malaria [*Plasmodium malariae*], but no malaria parasites were revealed [*cf.* **18** 46]. Of a number of females of *A. gambiae*, Giles, and *A. funestus*, Giles, fed on a man infected with blackwater fever, 29 of the former and 14 of the latter were fed on a volunteer 7–17 days after the infecting feed and 24 of the former and 11 of the latter on another volunteer 18–32 days after. There were no reactions in either volunteer in the course of about 4 months, and dissection of 17 examples of *A. gambiae* and 14 of *A. funestus* did not reveal parasites in the stomachs or salivary glands.

Collections of ticks received from various parts of the country all consisted of *Ornithodorus moubata*, Murr. The causal organism of relapsing fever [*Spirochaeta duttoni*] was observed in fluid exuding after the removal of the mouth parts in 2 examples out of 123, but not in the haemocoele of 175 nor in the fluid exuded after feeding from the anus and coxal glands of 22 others.

van Poeteren (N.). **Verslag over de werkzaamheden van den Plantenziektenkundigen Dienst in het jaar 1938.** [Report on the Work of the Phytopathological Service in 1938.]—*Versl. PlZiekt. Dienst Wageningen* no. 93, 92 pp., 4 pls. Wageningen, 1939.

In a brief section (pp. 41–42) of this report, it is stated that a number of straw bottle-covers exported from Holland in February 1938 were found, some time after receipt, to be heavily infested by mites, which caused severe dermatitis to persons coming into contact with them. When samples of the covers were returned to Holland and kept in a damp environment, mites became numerous in them ; they were identified as *Tyroglyphus* (*Aleurobius*) *farinae*, DeG. No mites were observed in covers that had been stored in Rotterdam and were subjected to similar treatment. After export, the originally infested covers had been kept for two months under a tarpaulin in the open air, and it is concluded that these conditions had favoured the increase of the mite.

Herzig (A.). **Eine neue Rickettsia-Spezies der Laus, der Erreger einer spontan aufgetretenen epidemischen Erkrankung des Menschen.** [A new *Rickettsia* of the Louse, the Agent causing a spontaneous epidemic Disease of Man.]—*Zbl. Bakt.* (1, Orig.) **143** no. 5–6 pp. 299–302. Jena, 1939. **Untersuchungen über** *Rickettsia pediculi*. [Investigations on *R. pediculi*.]—*T.c.* pp. 303–305.

The author gives an account of an outbreak of a mild disease that occurred in 1938 among the persons on whom were fed the lice [*Pediculus humanus*, L.] used in the production of anti-typhus vaccine at the Institute of General Biology of Lwow. Examination revealed that most of the lice in all the batches that had fed on the persons who fell ill were infected with exclusively extra-cellular rickettsiae that corresponded exactly with *Rickettsia pediculi*. The lice had obviously obtained the infection by sucking the blood of the infected person, since rickettsiae were also observed in normal lice into which the blood of such persons had been injected, whereas control lice remained uninfected. Such rickettsiae were also seen in the peripheral blood of the infected persons. Experiments are described which showed that these rickettsiae were the cause of the disease and not merely an accidental accompaniment of it. Although they multiplied in the course of passages through lice or when injected from louse to louse, all strains soon lost their pathogenicity for man. They were not pathogenic for laboratory animals and did not multiply when passaged through them. In all points studied, this species of *Rickettsia* greatly resembled *R. weigli* [*cf. R.A.E.*, B **25** 76], the causal organism of rickettsaemia weigli [**23** 257], and *R. quintana* [*cf.* **11** 149], the causal organism of trench fever. Either these diseases are only different forms of a single type of disease with basically the same etiology and caused by a single specific causal organism, in which case differences in symptoms would be due to the greater or lesser virulence of the causal organism and would not be constant, or the rickettsiae, although related, belong to different races, subspecies or species. The results of serological researches support the second view. The author suggests that the outbreak in 1938 was due to the large numbers of lice (about 50,000) fed daily on numbers of persons ; under such conditions opportunities are provided for ordinarily harmless saprophytes or

symbionts of man or louse to change into pathogenic forms. This change is possible for only a small number among millions of organisms. When louse infestation is small, the possibility remains practically non-existent, and even if it is realised, the pathogenic organism remains confined to an individual host, whereas when large numbers of lice and men are involved, not only does the possibility of the change become greater, but the hosts necessary for growth and increase of the pathogenic organisms are present, and an outbreak may occur. Since the incubation period is short (about 3 days), the epidemic spreads rapidly. Thus a heavy louse infestation, in which some of the lice are always infected with *R. pediculi*, may be the source of an outbreak, even though no other disease-causing organism be present. The same rickettsiae were obtained from lice taken from two other persons that fell ill with symptoms similar to those of the laboratory personnel, with whom, however, they had had no contact. Among the cases observed were some in which no relapses occurred, and inapparent infections were revealed by experiments using lice.

In the second paper, the author points out that research on *R. pediculi* has hitherto been neglected because it has been regarded as a harmless parasite of the louse that is also non-pathogenic for man, and that this has led to the dissemination of numbers of mistaken statements and theories regarding diseases caused by species of *Rickettsia*. She has been carrying out experiments on the subject for several years and gives the preliminary results. It has been proved that *R. pediculi* is not a single entity, but a collective name for a series of nearly related but sharply differentiated species of micro-organisms. It was possible to employ serological criteria (agglutination, precipitation and complement fixation), which it had not been possible to use previously for technical reasons. The most important result of these experiments has been to show that a strongly pathogenic strain of *R. weigli* became transformed after several passages through lice into a completely non-pathogenic parasite of the form of *R. pediculi*. This suggests that strains of louse-parasites that are not pathogenic for man may equally well become transformed, under favourable circumstances, into pathogenic forms. The problem of the origin of *R. pediculi* was also investigated. Several possibilities are discussed and the one considered most probable is that it is normally present in perfectly healthy persons and that some disturbance of the equilibrium between it and its host allows it to increase and appear in the peripheral blood, whence it is taken into the stomach of the louse.

Isăcescu (D. A.) & Manolache (C.). **Le phénomène de cumulation des gaz toxiques chez les insectes. I-ère Note. La dose léthale de l'oxyde d'éthylène et de la chloropicrine chez** *Cimex lectularius*.—*Bulet. Soc. Chim. Român.* **18** no. 3–4 pp. 183–189, 2 graphs, 4 refs. Bucharest, 1936. [Recd. 1939.]

Fumigation experiments with T-gas (consisting of 90 parts ethylene oxide and 10 parts carbon dioxide) against *Cimex lectularius*, L., confirmed the findings of Mayer [*cf. R.A.E.*, A **23** 121] that Haber's formula may be applied in experiments against insects provided that the retarded effects of the gas are taken into account. The bugs were subjected to a continuous stream of air flowing at a constant rate and containing various concentrations of T-gas [*cf. loc. cit.*]. To avoid

errors due to different rates of inspiration, the temperature was maintained at 19–20°C. [66·2–68°F.], and with 10 per cent. of carbon dioxide in the mixture the bugs remain at the same level of activity [cf. A **20** 696]. The lethal product of the gas was considered to be that combination of concentration and period of exposure that will bring about complete mortality in 4 days, since 1–4 days was the time required for complete mortality among insects exposed to a concentration of 50 mg. per litre (or 50 gm. per cubic metre, which is the concentration recommended for fumigation) according to the duration of exposure. The results of experiments in which the time of exposure was varied from 170 minutes to 20 and the concentration in mg. per litre from 30 to 150 are shown in a table, from which it is concluded that complete mortality is ensured in 4 days by a time-concentration product of 4,000. When this product is 4,600, complete mortality is obtained on the first day, and when it is 3,000, complete mortality is obtained in 10 days. In similar experiments with chloropicrin, in which the concentrations were varied from 1 to 9 mg. per litre and the time from 740 to 67 minutes, the lethal product causing complete mortality in 4 days was 623. The practical conclusions drawn from these results are that the time of exposure recommended with a concentration of 50 gm. per cu. m. may be reduced from 24 hours to 2 and complete mortality will still be obtained on the first day, since the product of 50 × 120 is 6,000, and that the concentration may be reduced if complete mortality retarded up to the fourth day is allowed for. For chloropicrin, a concentration of 5 gm. per cu.m. with an exposure of 125 minutes is sufficient.

Toumanoff (C.). **Quelques remarques au sujet d'un travail de R. Senior White sur les indices maxillaires des anophelinés des Indes.**—*Rev. méd. franç. Extr.-Orient* **17** no. 7 pp. 865–870, 5 refs. Hanoi, 1939.

In connection with the problem of the relation of the maxillary indices of Anophelines to their food-preferences in Indo-China, the author elucidates one or two points discussed by R. Senior White at the end of a paper already noticed [*R.A.E.*, B **26** 37].

Toumanoff (C.), Try (H. T.) & Chang (T. L.). **Au sujet de l'existence de** *Filaria malayi* **et** *F. bancrofti* **dans la Haute-Région tonkinoise et du rôle probable des diverses espèces culicidiennes dans la transmission de la filariose humaine.**—*Rev. méd. franç. Extr.-Orient* **17** no. 7 pp. 871–876, 3 refs. Hanoi, 1939.

Observations made in the course of a tour through the high and middle regions of Tonkin confirmed the presence of *Filaria malayi* in Indo-China [cf. *R.A.E.*, B **25** 233] and also show that the distribution of both this species and *F. bancrofti* is not limited to the delta region, but that they also occur in the high region, where *F. malayi* is sometimes found more frequently than *F. bancrofti*. Although *Anopheles hyrcanus* var. *sinensis*, Wied., may be the chief vector of both species of *Filaria* in the delta or in places where cattle are rare and it is forced to attack man [cf. **28** 73], it must be less important in the high region, where cattle are abundant. Nothing is definitely known of the vectors there, but among Anophelines dissected for malaria parasites between 1931 and 1939, filarial infections were found in 16 out of 3,646 females of

A. minimus, Theo., and in 3 out of 2,012 of *A. jeyporiensis*, James, taken in one locality. Moreover, in two localities, precipitin tests revealed human blood in 93 and 97 per cent. of the females of *A. minimus* and 97 and 61 per cent. of those of *A. jeyporiensis*, and malaria parasites were frequently found in both species. Thus, it seems likely that the filarial infections were obtained from man. The numbers found would probably have been higher had special attention been directed to their discovery. In south Annam and Cochin China, no filarial infections were observed in these mosquitos. At Haiduong, where, owing to the absence of cattle, *A. hyrcanus* var. *sinensis* frequently attacks man, filarial infections were found in 5 females of this species out of 1,319 dissected.

Papers noticed by Title Only.

Davis (G. E.). *Rickettsia diaporica*: **Recovery of three Strains from** *Dermacentor andersoni* **collected in southeastern Wyoming: their Identity with montana Strain 1.**—*Publ. Hlth Rep.* **54** no. 50 pp. 2219–2227, 4 figs., 2 refs. Washington, D.C., 1939. [*Cf. R.A.E.*, B **27** 146; **28** 80.]

Bertram (D. S.). **The Structure of the Capitulum in** *Ornithodoros*: **a Contribution to the Study of the Feeding Mechanism in Ticks.**—*Ann. trop. Med. Parasit.* **33** no. 3–4 pp. 229–258, 22 figs., 28 refs. Liverpool, 1939.

Lewis (D. J.). **The Male and the Early Stages of** *Anopheles wellcomei* **Theobald.**—*Ann. trop. Med. Parasit.* **33** no. 3–4 pp. 197–200, 2 figs., 2 refs. Liverpool, 1939.

Tulloch (G. S.). **A Key to the Mosquitoes** [adults and larvae] **of Massachusetts.**—*Psyche* **46** no. 4 pp. 113–136, 5 pls., 16 refs. Cambridge, Mass., 1939.

Lane (J.). **Catálogo dos Mosquitos neotrópicos.** [Catalogue of the Neotropical Mosquitos.]—*Bol. biol.* Ser. monogr. no. 1, 218 pp., 34 pp. refs. S. Paulo, Club. zool. Brasil, 1939.

Lane (J.) & Porto (C. E.). **Simulídeos da região neotrópica. O gênero** *Eusimulium*.—*Bol. biol.* (N.S.) **4** no. 2 pp. 168–176, 7 figs. S. Paulo, 1939.

Porto (C. E.). **Simulídeos da região neotrópica. (II. Gênero** *Simulium*).—*Bol. biol.* (N.S.) **4** no. 3 pp. 369–373, 3 figs. S. Paulo, 1939.

Martorell (L. F.). **Insects observed in the State of Aragua, Venezuela, South America** [a briefly annotated list].—*J. agric. Univ. P.R.* **23** no. 4 pp. 177–232. Rio Piedras, P.R., 1939.

Martorell (L. F.) & Escalona Salas (A.). **Additional Insect Records from Venezuela.**—*T.c.* pp. 233–264.

Mellanby (K.). **Low Temperature and Insect Activity.** [Experiments on *Glossina palpalis*, R.-D., blowflies, cockroaches, *Cimex lectularius*, L., and *Rhodnius prolixus*, Stål].—*Proc. roy. Soc.* (B) **127** no. 849 pp. 473–487, 19 refs. London, 1939.

Baba (K.). **Die dem Menschen Hautenzündung verursachenden Käfer.** [The Beetles causing Dermatitis in Man).]—*Kontyû* **13** no. 5–6 pp. 242–246. Tokyo, 1939.

RUSSELL (P. F.) & MOHAN (B. N.). **Further Observations on experimental Malaria Infections in *A. stephensi* from contrasting Larva Environments.**—*Amer. J. Hyg.* **31** (C) no. 1 pp. 19–25, 6 refs. Lancaster, Pa, 1940.

Further experiments, using females of *Anopheles stephensi*, List., obtained from larvae reared in tap water and in sullage water containing up to 5 parts per 100,000 of ammoniacal nitrogen and 0·6 of albuminoid nitrogen, confirmed previous results [*R.A.E.*, B **28** 44], since there was practically no difference in the susceptibility to infection with malaria parasites of the females from the two types of breeding water, the average sporozoite rates being 16·4 and 18·3 per cent. for the tap-water and sullage-water series, respectively. A man was infected with *Plasmodium falciparum* by females from larvae reared in sullage water. Adults of both sexes from sullage-water series had a greater average weight and females took more blood than those from the tap-water series, which may have accounted for the higher sporozoite rate. Precipitin tests on mosquitos that had been stained and kept for one night in a cage containing a man and a calf did not indicate that larval environment had any effect on their food-preferences, the man-positive reactions being 2·9, 4·4 and 7·4 per cent., and the cow-positive 98·6, 97·8 and 94·4 per cent. for the series from tap-water, cow-dung water [*cf. loc. cit.*] and sullage-water, respectively. One mosquito in each series had fed on both man and calf.

MACHSOES (M.). *Anopheles barbirostris* **als malaria-overbrenger in de residentie Celebes.** [*A. barbirostris* as a Vector of Malaria in the Celebes Residency.]—*Geneesk. Tijdschr. Ned.-Ind.* **79** pt. 40 pp. 2500–2515, 4 maps. Batavia, 1939.

VENHUIS (W. G.). **Voorloopige entomologische mededeelingen omtrent** *An. barbirostris* **van Celebes.** [Preliminary entomological Communications on *A. barbirostris* of Celebes.]—*T.c.* pp. 2515–2519. (With a Summary in English.)

The first paper comprises an account of observations in 1938–39 on *Anopheles barbirostris*, Wulp, in three freshwater districts in Celebes, in each of which epidemics of malaria occurred. The topography of these localities is described, and data are given on the spleen rates that were observed in the inhabitants. In all, six species of Anophelines were taken in houses, and of these *A. barbirostris* was by far the most numerous. Dissections were made of the mosquitos collected, and malaria infection was found in *A. barbirostris* in all three districts and in *A. hyrcanus*, Pall., in one only. The numbers of the former dissected in the three districts were 517, 524 and 242; 68, 58 and 4 were infected, 22, 6 and 0 showing infection in the salivary glands. The corresponding figures for *A. hyrcanus* in the second district were 587, 51 and 6. Brief notes are given on the breeding places that were observed in each of the three districts.

In the second paper it is stated that the form of *A. barbirostris* from Celebes is morphologically very similar to the typical *A. barbirostris*, which was described from Java, but differs from it in the narrowness of the white band between the third and fourth segments of the hind tarsi. There is a great difference in feeding habits; the typical form is zoophilous [*cf. R.A.E.*, B **23** 232] and is very seldom taken in houses, while it has never been found infected with malaria. In view

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of these differences, the author considers that the form from Celebes should have varietal status and should be called *vanus*, Wlk., the name given by Walker in 1860 to an Anopheline in Celebes that is usually considered to be *A. barbirostris*.

STRICKLAND (C.). **Malaria in Chota Nagpur.**—*Indian med. Gaz.* **74** no. 12 pp. 737–740, 4 figs., 4 refs. Calcutta, 1939.

The author discusses the fact that villages on the Chota Nagpur plateau are only mildly malarious, whereas malaria is severe in those situated in or at the top or bottom of the steep valleys (ghats) that descend the face of the escarpment from the plateau. He suggests that, if the difference in the incidence of malaria is not due to differences in the Anopheline vector, it is probably related to physiography, since the villages are similar in all other points. During the rains, few Anophelines are found in the streams of either plateau or valleys, since most of them are swept away. During the fine weather, few pools are formed in the sandy beds of the plateau streams and the equable and gentle flow of the water renders the larvae more accessible to their natural enemies, but rocky pools from which there is no surface flow occur in the beds of the valley streams and these present conditions that are ideal for the breeding of mosquitos, long before natural enemies such as fish can become established. It is possible that, on the plateau, mosquitos are more frequently deviated by domestic animals. The reservoirs formed by damming a line of surface drainage contain few larvae and this may also be due to the presence of natural enemies. Most of the streams at the head of the valleys dry up in the hot weather and, although the streams at the foot of the valleys flow for a longer period, the heat of the plains is so great that malaria parasites do not develop and mosquitos die out ; thus it is only in the autumn that mosquito breeding takes place in both these tracts.

WISEMAN (R. H.), SYMES (C. B.), MCMAHON (J. C.) & TEESDALE (C.). **Report on a Malaria Survey of Mombasa.**—Med. 8vo, [4] 60 pp., 3 pls., 1 fldg plan, 3 figs., 8 refs. Nairobi, 1939.

Although the incidence of malaria at Mombasa has decreased appreciably during recent years, cases still occur occasionally in some numbers. A detailed account is given of malaria and mosquito surveys carried out from May 1936 to May 1937 as a preliminary to evolving a comprehensive scheme for dealing with the problem of this "residual" malaria. Information was also collected during the mosquito survey on the prevalence of *Aëdes aegypti*, L., in connection with the possible introduction of yellow fever, particularly since Mombasa has been made a port of call for the Imperial Airways Flying Boat Service between Europe and South Africa.

The clinical survey indicated that the incidence of malaria is high ; the high spleen and parasite rates and the fact that they were higher in children than in adults indicated an acute exacerbation of an endemic situation. On the island, the incidence is greatest in the two main African areas ; on the mainland, the general incidence is very high. The monthly incidence shows a peak period in May–August, following the long rains, and a smaller secondary wave in December and January, following the short rains.

The work on mosquitos included searches for breeding places in land not included in house compounds (" outside " breeding places),

in houses and their compounds, in wells and in tree holes; searches for adults in and around houses and in bush and other natural harbourages out of doors; a staining experiment to ascertain whether it was possible for the island to be invaded by adults from the mainland; a small number of dissections to determine the rate of infectivity; and examination of mail trains arriving at Mombasa, to determine the part they play in introducing mosquitos.

The 61 species of mosquitos recorded included 7 Anophelines. *Aëdes aegypti* was by far the most prevalent species in Mombasa; the larvae occurred in 33 per cent. of the outside breeding places, 9 per cent. of those in houses or compounds on the island and 19 per cent. of similar ones on the mainland, and were also obtained from trees, banana and pineapple plants and occasionally wells. Larvae of *Anopheles gambiae*, Giles, occurred in 1·6 per cent. of the outside breeding places on the island and in 11 per cent. of those on the mainland. They were found on 12 occasions in artificial containers and in 1·4 per cent. of the wells searched. The adults occurred in nearly 6 per cent. of the houses visited on the mainland, but were rare in those on the island; considerable numbers were brought into the town by train. The infectivity rate for the year was 3·1 per cent. Small numbers of larvae of *A. funestus*, Giles, were found in natural waters and in wells on the mainland and a few adults in houses; it is assumed, however, that the population of this species is much larger than is suggested by the numbers collected. *A. gambiae* and *A. funestus*, which were the only Anophelines present in houses, are undoubtedly the vectors of malaria in Mombasa, the former being responsible for all the cases on the island and for most of those on the mainland. *Culex fatigans*, Wied., was the commonest mosquito in houses; it bred in a variety of water containers and most abundantly in pit latrines; it is known to be a carrier of *Filaria* (*Wuchereria*) *bancrofti* elsewhere, and as this disease occurs both up and down the coast, there is little reason to doubt that it is a vector in Mombasa.

Of the species of mosquitos that have been shown experimentally to transmit yellow fever or to harbour the virus, *Aëdes simpsoni*, Theo., *A. vittatus*, Big., *Eretmapodites chrysogaster*, Graham, *Mansonia* (*Taeniorhynchus*) *africanus*, Theo., *M.* (*T.*) *uniformis*, Theo., and *Culex thalassius*, Theo., have been taken in Mombasa. If a mosquito infected with yellow fever were brought to Mombasa, with its dense population of susceptible persons and its abundant vectors, there would not only be a major catastrophe, but the damage to the country's sea trade would be almost irreparable. The coastal districts would almost certainly become endemic areas, since monkeys, which may act as reservoirs, are present and possible vectors are plentiful. It is believed that the measure most likely to afford protection from yellow fever is the eradication of mosquitos in and near airports. The fact that *A. aegypti* is also a vector of dengue, which occurs in neighbouring countries, is regarded as an additional reason for its control.

Recommendations are made for eliminating the breeding places of the actually or potentially dangerous mosquitos, and it is suggested that measures should be taken for the destruction of adults in trains and aircraft. In addition to such usual operations as filling and draining, oiling, and dusting with Paris green, the recommendations include the filling of rot-holes in trees, preventing the accumulation of water in the steps cut in the trunks of coconut palms by cutting V-shaped drainage channels in them, the provision of mosquito-proof

covers for wells, and the periodic clearing of vegetation to facilitate the removal of all water-holding refuse. Experiments with stained mosquitos showed that *A. aegypti* and certain other mosquitos can reach the island from the mainland, and there is no reason to suppose that *A. gambiae*, which is a strong flyer, cannot do so too.

GOUGET (R.). **La campagne antipaludique de 1938 dans le département d'Oran.**—*Arch. Inst. Pasteur Algérie* **17** no. 4 pp. 578–584. Algiers, 1939.

An account is given of the work carried out and the results obtained in the campaign against Anophelines and malaria in the department of Oran, Algeria, in 1938 [*cf. R.A.E.*, B **27** 118; **28** 78]. It is concluded that, on the whole, the results obtained were satisfactory.

SENEVET (G.). *Aëdes aegypti* **en Algérie.**—*Arch. Inst. Pasteur Algérie* **17** no. 4 pp. 598–600, 8 refs. Algiers, 1939.

The distribution of *Aëdes aegypti*, L., in Algeria is reviewed from the literature. It breeds in large numbers in the coastal towns and is found in the Tell Atlas in the departments of Oran and Constantine and at Ghardaia in the Sahara.

SHUTE (P. C.). **Supernumerary and bifurcated Acini of the Salivary Glands of** *Anopheles maculipennis*.—*Riv. Malariol.* **19** (1) pt. 1 pp. 16–19, 2 pls., 2 refs. Rome, 1940. (With a Summary in Italian.)

The author describes a new technique for dissecting the salivary glands of Anophelines that makes it easy to wash the entire glands and separate and examine the acini. Since abnormal glands were observed very frequently in the laboratory, in Surrey it was decided to ascertain the degree of variation that occurred as well as the percentages showing variation. The data recorded were obtained from *Anopheles maculipennis*, Mg., race *atroparvus*, van Thiel, from stock bred in the laboratory for several years and from females caught in nature in June 1939. It was found that about 20 per cent. of the reared females and 30 per cent. of the others had either supernumerary or bifid acini. All the abnormalities occurred in the side lobes, and in no case was an abnormal or bifid middle acinus seen. It is a common observation that malaria sporozoites are more numerous in the middle acinus than in the side ones. It is probable, therefore, that the additional acini do not enable the mosquitos possessing them to harbour a greater number of sporozoites or to remain infective for longer periods than mosquitos with normal glands.

CORRADETTI (A.). **L'epidemiologia della malaria nella regione Uollo Jeggiu (Africa Orientale Italiana).** [The Epidemiology of Malaria in the Uollo Jeggiu Region, Italian East Africa.]—*Riv. Malariol.* **19** (1) pt. 1 pp. 39–64, 8 figs., 4 pls. Rome, 1940. (With Summaries in English and German.)

The results are recorded of observations from July 1937 to February 1939 on malaria and Anophelines in the region of Dessie, Abyssinia, much of which has already been noticed [*cf. R.A.E.*, B **26** 183, 215;

28 61]. Descriptions are given of the topography and climate of the region, the composition of and variation in the European population, the incidence of malaria in relation to rainfall, the Anopheline fauna in relation to malaria, and the epidemiology of malaria at various altitudes. The percentages of infections due to *Plasmodium falciparum* (*immaculatum*), *P. vivax*, and a mixture of the two were 52·2, 44·9 and 2·8. No malaria occurred above 6,600 ft. *Anopheles gambiae*, Giles, was the commonest vector, while *A. pharoensis*, Theo., was of much less importance and the other species played no part in transmission. Control of *A. gambiae* would be extremely difficult owing to the temporary nature and frequency of its breeding places and its rapid development (the larval stage lasts 9–10 days at about 6,000 ft. and correspondingly less at lower altitudes). Dusting with Paris green from an aeroplane might be successful in some areas.

CORRADETTI (A.). **Su alcune larve di *Anopheles* rinvenute a Ghinda (Eritrea) e descrizione di una nuova larva : *Anopheles* (*Myzomyia*) *erythraeus* n. sp.** [On some Larvae of *Anopheles* found at Ghinda and Description of a new Larva, that of *A. erythraeus*, sp. n.]—*Riv. Parassit.* **3** no. 4 pp. 287–292, 6 figs., 6 refs. Rome, 1939. (With Summaries in English, French, German.)

Anopheles (*Myzomyia*) *erythraeus*, sp. n., is described from a single larva taken together with larvae of *A. dthali*, Patton, and *A. macmahoni*, Evans, from the bed of a half dry stream at Ghinda, a locality situated at about 3,000 ft. on the Massawa-Asmara road in Eritrea. Characters are given distinguishing the larva of the new species from those of *A. theileri*, Edw., and other allied species.

DEL VECCHIO (G.). **Osservazioni sulle ninfe di *A. claviger* (*bifurcatus*). Nota II. *A. claviger* var. *petragnanii*.** [Observations on the Pupae of *A. claviger*. Note II. *A. claviger* var. *petragnani*.]—*Riv. Parassit.* **3** no. 4 pp. 305–316, 3 pls., 4 refs. Rome, 1939. (With Summaries in English, French, German.)

Continuing his investigations on the varieties of *Anopheles claviger*, Mg., in Littoria [*R.A.E.*, B **27** 175 ; **28** 11], the author describes and discusses characters of the pupa of *A. claviger* var. *petragnani*, Del Vecchio.

CAMBOURNAC (F. J. C.) & HILL (R. B.). **The Biology of *Anopheles maculipennis*, var. *atroparvus* in Portugal.**—*Acta Conv. ter. Malar. Morb.* **2** pp. 178–184. Amsterdam, 1938.

In Portugal, *Anopheles maculipennis*, Mg., race *atroparvus*, van Thiel, is responsible for the transmission of hyperendemic malaria in some areas and for sporadic outbreaks in others, whereas it is present in still other areas where malaria is unknown [*cf. R.A.E.*, B **26** 217]. For this reason, special attention has been paid to its biology under different conditions, and in this paper are summarised the results of observations over a period of 5 years, with special reference to the hyperendemic area of Aguas de Moura.

Although appreciable variations in the morphology of the egg occur in the same locality and even in the same batch of eggs, the pattern and type of float are essentially those described by van Thiel and other

authors for this race [but *cf.* next paper]. The length and width of the egg, length of float and relation of float-length to egg-length vary considerably in the same batch. In one batch from a female caught in nature the float-length varied from 19 to 41 per cent. of the total egg-length and in another from 22 to 45 per cent. On the average, the float-length is about 34 per cent., and in most batches the variation is approximately 10 per cent. The larval and adult characters are similar to those described by other authors, but again considerable variations were found in each of the characters commonly used for classification.

The larvae develop in practically all clean waters with a negative bio-chemical oxygen demand and a pH between 6 and 8, provided that there is sunlight, some vegetation and little or no current. Such waters include swamps, canals, irrigation and drainage ditches and other semi-permanent collections of water, especially rice-fields. In rice-fields, the concentration of larvae is greater than elsewhere, and on account of their extent, they produce at least 90 per cent. of all Anophelines in Portugal. They are flooded from May to September and so constitute a source of adults throughout the malaria season. The larvae can withstand, and may even be favoured by, relatively high temperatures. Three years' observations have shown that the temperature of the water in rice-fields at 4 o'clock in summer varies from 24 to 32°C. [75·2 to 89·6°F.], with means of 27, 29 and 26°C. [80·6, 84·2 and 78·8°F.] for June, July and August, respectively. Though breeding is prolific near tide water, where many rice-fields are situated, it occurs only in fresh water. The larvae are found in water with a total chloride content of between 50 and 130 mg. per litre. When the salinity rises, they are replaced by larvae of the genus *Aëdes*, but they appear again when the salinity is reduced to 170 mg. Under laboratory conditions, adults may be obtained from larvae reared in water containing up to 0·8 per cent. sodium chloride, but the larval mortality is high and development is prolonged.

At room temperatures in the spring and summer, about 80 per cent. of the gravid females caught in nature will oviposit in small vials. The percentage diminishes in September, and is only about 3 during November–January. It rises suddenly to 70 about the middle of February. In nature, a few scattered eggs and larvae are found in January, but they do not appear in any numbers until the middle of February. The first males appear at the beginning of March and the last ones die in December. In the relatively mild climate, in which the temperature falls to 0°C. [32°F.] only for short periods, the females do not usually hibernate. During September, fat begins to develop, and oviposition is suspended in October, when approximately 4 per cent. of the females contain both fat and partly-developed eggs in which further growth is suspended. Females taking refuge in well-built and relatively warm inhabited stables and rabbit hutches increase in numbers until January. They are not found in houses or attics during the autumn and winter or even in spring until the new generations appear. During relatively warm winter days, feeding takes place and movement into the open occurs. In two rabbit pens where all the Anophelines were caught each week for three years, the population was renewed each week in both winter and summer. Females caught in nature about the middle of October or bred in the laboratory (the latter either infected with *Plasmodium* or not) survived the winter in small cages, whether unfed or given a weekly blood meal. Most

of them died off suddenly towards the end of January, but a few survived until the last week in May. In nature, there is also a sudden falling off in the numbers in shelters at the end of January, but many survive, and those captured live as long as those kept in cages through the winter. Overwintered females, after taking a blood meal in spring, laid from 2 to 4 batches of viable eggs.

In spring, the life-cycle from egg to adult lasts about 30 days, but in summer the average is 18 days ; 6–7 generations occur in a year. In rice-fields, the number of larvae increases up to June, when the average number per square metre was 400. This number falls to 100 in July and 70 in August. A similar decrease occurred in the numbers of adults caught as the summer advanced. The length of life of the adult, whether infected or uninfected, varied from 7 months in winter to about 2 months in summer. The adults are extremely resistant to high temperatures. Their preferred shelters are sheds containing animals, but if they are very abundant, they invade all shelters and in this way some find their way into houses. They feed under cover or near shelters, but never in the open ; repeated attempts to catch females with human or animal bait in the open fields or in the vicinity of rice-fields invariably failed. The flight range of the female when hungry is at least 3 kilometres [*cf.* **23** 236], but after feeding it can fly with difficulty only a few yards. Most females feed after dusk, but the race in the region of Aguas de Moura does not necessarily feed only at night, and in subdued light will attack man and animals at any time of the day. Although the blood of rabbits, horses and pigs, in that order, is preferred, all the usual domestic animals and man are attacked when hosts are relatively scarce. The tendency of this Anopheline to take any available food, together with the chance selection of houses for shelter, would appear to be largely responsible for the continuance of hyperendemic malaria. When its density is high, malaria is endemic ; when its density is low, the small numbers attacking man make it an inefficient vector. Thus its capacity as a vector depends largely on its abundance.

TREILLARD (M.). **Au sujet d'une variété méridionale de l'*Anopheles maculipennis*.**—*Bull. Soc. path. exot.* **32** no. 10 pp. 934–936, 5 refs. Paris, 1939.

The author points out that in July 1936 several females of *Anopheles maculipennis*, Mg., were sent from the region of Aguas de Moura in Portugal by F. J. C. Cambournac for identification. They laid spotted eggs with floats sufficiently short to enable them to be distinguished immediately from those of race *atroparvus*, van Thiel. Measurements made on a large number of eggs from the same batch and on several batches from the same female, from several contemporaneous females and from females of subsequent generations showed that this character was remarkably stable with variation of only 2–3 per cent. The float index [*cf. R.A.E.*, B **21** 211] averaged 0·26, whereas those for strains of race *atroparvus* are 0·37 (La Vendée), 0·38 (Italy) and 0·40 (Holland). The race was considered distinct and named *cambournaci* [*cf.* **25** 2]. The same race was found in 1937 in Camargue [*cf.* **25** 170], where race *atroparvus* also occurs. A comparison of these strains and the strain of *atroparvus* from La Vendée showed that *cambournaci* paired more readily in a confined space and that the duration and intensity of the diapause or retarded reproduction

were much less marked in this race. Since that time, further observations on strains from Camargue have confirmed the validity of the distinguishing characters. The float index was found to be as low as 0·21. Moreover, a difference was observed in the pattern on the dorsal surface of the egg.

The author expresses surprise that Cambournac and Hill [see preceding paper] report observations on race *atroparvus* only, although their investigations were carried out in the very region from which race *cambournaci* was described. He points out that these authors do not mention rearings carried out in series through several generations, and suggests that the batches of eggs in which the float indices cover the ranges for both races (0·19 to 0·45) may have been the result of hybridisation.

Cambournac (F. J. C.) & Hill (R. B.). **Observation on the Swarming of** *Anopheles maculipennis*, **var.** *atroparvus*. *Amer. J. trop. Med.* **20** no. 1 pp. 133–140, 2 figs., 1 ref. Baltimore, Md, 1940.

The following is based on the authors' summary of observations at Aguas de Moura, Portugal, on the swarming of race *atroparvus*, van Thiel, of *Anopheles maculipennis*, Mg., which, they state, is the only race found in this area [*cf.* preceding abstract]. The males swarm after sunset, beginning activity when the light intensity measures about 40 foot-candles, although temperature and probably humidity are also factors influencing time of swarming. The swarming occurs either inside buildings, in semi-enclosed pens, or in the open air. Most, but not all, females are fecundated while resting under shelter, without preliminary swarming of the male. Only a relatively few females enter the swarm. Hence it is suggested that swarming has largely lost its functional character, although it still takes place. The process of mating is described.

Clark (H. C.), Komp (W. H. W.) & Jobbins (D. M.). **A ninth Year's Observations on Malaria in Panama, with Reference to the Occurrence of an Epidemic following continued Treatment with Atabrine and Plasmochin.**—*Amer. J. trop. Med.* **20** no. 1 pp. 47–67, 9 refs. Baltimore, Md, 1940.

This is a report of observations made during the period from September 1938 to September 1939 on the incidence of malaria in certain villages in Panama where the effect of various drugs has been studied since 1930 to determine the feasibility of control by this means in an area where anti-mosquito measures are too costly to be practicable. Little active malaria was present before July 1939, but an epidemic occurred in August and September and was still in progress at the end of the period. For the first time, information was obtained on the seasonal prevalence of the larvae and adults of the Anophelines in the area concerned. Mosquito production is not directly dependent on rainfall, most of the larvae being found in the vegetation-covered lagoons and backwaters of the Chagres River, which are full during the entire year. In 1939, breeding conditions on this river between Madden Dam and Gamboa were very different from those in previous years. Near the end of the rainy season (December 1938), about six times the normal flow of water was released from the Madden Lake into the river, and affected the vast areas of aquatic vegetation that favoured mosquito breeding in the vicinity of the villages on the banks

of the river. The floating plant, *Pistia stratiotes*, in which *Anopheles triannulatus*, Neiva & Pinto (*bachmanni*, Petrocchi) breeds, was almost entirely swept away, and an attached floating plant, *Cabomba aquatica*, with which larvae of *A. albimanus*, Wied., are associated, no longer reached the surface. The discharge was continued in January and February 1939 at a greater rate than that of the previous year. By March the flow was reduced, and, as a result of the previous discharge, the water level in the river between Madden Dam and Gamboa was 18 per cent. lower than in March 1938. *Cabomba* appeared on the surface in quantity towards the end of March, and numbers of *A. albimanus* occurred in it ; the low level of the river favoured the persistence and spread of the plant. At the end of May, water usually enters the river from Madden Lake, but in 1939 water was held in storage for more than 4 months after the beginning of the rains in May and the water in the river became more or less stagnant, a factor that also favoured mosquito breeding. The centre of breeding moved upstream toward the native villages. Emergence of *A. albimanus* in large numbers occurred in the third week of April and continued at a slightly reduced rate through the first part of the rainy season. The numbers of females taken in houses in a village near the areas of intense breeding during April–July averaged between 10·7 and 16·6 per house per collection, as compared with less than one in a village 1½ miles from the river. There appeared to be a correlation between the abundance of Anophelines and the incidence of malaria in the former, but in the latter a sharp rise in the parasite rate was not preceded or accompanied by any increase in the numbers of mosquitos.

Carr (H. P.), Meléndez (J. F.) & Ros (A.). **Malaria Reconnaissance of the Province of Oriente in Cuba.**—*Amer. J. trop. Med.* **20** no. 1 pp. 81–97, 1 chart, 4 refs. Baltimore, Md, 1940.

A malaria survey of Cuba is to be made, and in this paper are given the results obtained in Oriente, the easternmost of the six provinces into which the Island is divided. Malaria is of low endemicity with periodic epidemics and is practically confined to altitudes of less than 1,000 feet. Collections of Anophelines, chiefly of larvae, were made throughout the Province. *Anopheles albimanus*, Wied., was the only species taken in any numbers ; it appeared to be more abundant at altitudes of less than 1,000 ft., and especially in the low-lying river valleys and deltas and the Cauto and great Camagüey plains. *A. grabhami*, Theo., occurred at higher altitudes. *A. vestitipennis*, D. & K., and *A. crucians*, Wied., were rare. Collections of adults by means of a calf-baited trap were made in part of Havana Province. They showed the overwhelming predominance of *A. albimanus* in rural and semi-rural areas at low altitudes. It was most abundant in the localities in which the malaria incidence was highest and increased in numbers at the time when malaria transmission was most active. The other three species again occurred in small numbers only ; *A. atropos*, D. & K., was found once.

Boyd (M. F.). **On the Correlation between the Incidence of Stomach and Gland Infection in** *Anopheles quadrimaculatus* **infected with** *Plasmodium vivax*.—*Amer. J. trop. Med.* **20** no. 1 pp. 129–131. Baltimore, Md, 1940.

The rate of infection with *Plasmodium vivax* of females of *Anopheles quadrimaculatus*, Say, dissected after a single blood meal at a time

when the parasites would still be in the oöcyst stage is compared with the rate in those dissected after an interval sufficient to allow the parasites to reach the salivary glands. The results indicate that, with large numbers of mosquitos, the rates of infection revealed by stomach and gland dissection will be in substantial agreement, though considerable divergence, attributable to random sampling, may be noted in the case of small groups. They also suggest that the natural mortality among mosquitos during the incubation period is unlikely to be due to malaria infection.

Bang (F. B.), Quinby (G. E.) & Simpson (T. W.). *Anopheles walkeri* (Theobald) **a wild-caught Specimen harboring Malarial Plasmodia.** —*Publ. Hlth Rep.* **55** no. 3 pp. 119–120, 1 pl., 3 refs. Washington, D.C., 1940.

Anopheles walkeri, Theo., has been suspected of being a vector of malaria in the Reelfoot Lake region of Tennessee and Kentucky because of its prevalence and its tendency to bite man [*cf. R.A.E.*, B **27** 128]. It has also proved capable of transmitting both *Plasmodium vivax* and *P. falciparum* in the laboratory [*cf.* **21** 148; **25** 27]. It was therefore decided to attempt to demonstrate malaria infection in females caught in nature. The most satisfactory method of collecting this species has always been by means of the New Jersey light-trap [*cf.* **26** 106], and dissections of females caught in this way showed that most of the ovaries were in stage 2 and that there was no blood in the gut; moreover, there were a few individuals with ovaries in stage 2 that had mature eggs retained from the previous oviposition. This was taken as evidence that some, if not most, of the females caught had taken a blood-meal. A series of dissections of the salivary glands of females from light-traps was, therefore, carried out in July 1939, and the 231st mosquito showed a heavy infection of sporozoites. It was also found to have 6 oöcysts on the stomach.

Aitken (T. H. G.). **The** *Anopheles maculipennis* **Complex of Western America (Diptera, Culicidae).**—*Pan-Pacif. Ent.* **15** no. 4 pp. 191–192, 3 refs. San Francisco, Calif., 1939.

The author considers that *Anopheles maculipennis*, Mg., is represented in North America by three subspecies, *occidentalis*, D. & K., *aztecus*, Hffm., and *freeborni*, n., which is distinguished by characters of the wing scales in the females, the male genitalia and the eggs. There has been confusion as to the status of *occidentalis*, because the type series is a mixture, including 64 specimens of *occidentalis* and 14 of *freeborni*. The distribution of *occidentalis* is limited to a narrow strip running along the west coast from the region of San Luis Obispo, in California, north to the Canadian Northwest Territory and across the continent along the international boundary to New England. It may prefer impounded water for breeding, in contrast to the fresh irrigation water favoured by *freeborni*. The latter occurs throughout the regions west of the Continental Divide, appearing on the coast in southern California; and *aztecus* is found in the Valley of Mexico.

GRAHAM (D. H.). **Mosquito Life in the Auckland District.**—*Trans. roy. Soc. N.Z.* **69** pt. 2 pp. 210–224, 2 pls., 1 fldg map, 4 refs. Wellington, N.Z., 1939.

This is a report of the results of investigations on the mosquitos of the Auckland District of New Zealand carried out over a period of three years. Brief notes are given on the distribution and habits of the nine species found to be established there, with records of the finding of two others, *Anopheles maculipennis*, Mg., and *Culex annulirostris*, Skuse, on ships arriving at Auckland. *Culex fatigans*, Wied., and *Aëdes notoscriptus*, Skuse, have been found in New Zealand only in the vicinity of ports and have probably, therefore, been introduced since the European occupation. The two species that are most annoying in the city and suburbs of Auckland are *Culex pervigilans*, Berg., which bites at night, and *A. notoscriptus*, which bites during the day [*cf. R.A.E.*, B **18** 58]; in country towns, *C. pervigilans* and *Taeniorhynchus iracundus*, Wlk., which bites both day and night, are the most troublesome species; and in the country proper, *Rachionotomyia argyropus*, Wlk., which bites at night, is also of importance. Evidence was collected which showed that the mosquitos attack cattle in preference to man. The natural enemies are discussed; among these, the native trout, *Galaxias fasciatus*, gave promising results in the control of mosquito larvae in both field and laboratory tests. The chief breeding places of mosquitos and the means that may be used to eradicate them are indicated. Although, with the exception of *Culex fatigans* and *A. maculipennis*, no mosquito vectors of disease have been discovered, the author points out the danger of their introduction by ship from overseas. A key to the species studied is appended.

GORDON (R. M.) & LUMSDEN (W. H. R.). **A Study of the Behaviour of the Mouthparts of Mosquitoes when taking up Blood from Living Tissue; together with some Observations on the Ingestion of Microfilariae.**—*Ann. trop. Med. Parasit.* **33** no. 3–4 pp. 259–278, 13 figs., 17 refs. Liverpool, 1939.

The following is based largely on the authors' summary: By means of the technique described, mosquitos (chiefly *Aëdes aegypti*, L.) were fed on the web of the foot of frogs (*Rana sphenocephala* from Florida). Owing to the transparency of the web, the movements of the fascicle in the tissue were visible, and observations could therefore be made on the means by which mosquitos take up blood. The mechanism of penetration differs markedly from the conceptions of previous observers. The tip of the fascicle is actively flexible and can be curved to allow penetration in almost any direction, and the rest accommodates itself to the curves previously pursued by the cutting tip. Blood is taken up either directly from a capillary or from an extravasation of blood derived from a previously lacerated capillary. Fluid, presumably salivary secretion, is injected into the tissues at various stages of penetration.

Microfilariae of *Foleyella dolichoptera* [*cf. R.A.E.*, B **28** 44] were abundant in the blood vessels of the web of some of the frogs, and their movements in the capillaries could easily be seen. The observations of other authors regarding the independent movement of microfilariae against the blood stream were, in part, confirmed. On the other hand, no evidence was obtained to support the suggestion of workers experimenting with *Filaria* (*Wuchereria*) *bancrofti* that microfilariae are

capable of purposive movement towards the site of feeding [*cf.* **20** 169; **25** 171]. Attention is drawn to the extreme variation that may occur in the numbers of microfilariae taken up by individual mosquitos fed on the same host. It is shown that this may be correlated to some extent with different types of feeding, feeding from blood extravasated into the tissues resulting in a much lower concentration of microfilariae than when blood is taken up directly from a capillary, probably because microfilariae escape less readily than blood cells from a torn capillary. Another cause of variation is that the concentration of microfilariae was found by direct examination of the web to vary considerably in different capillaries, even when they were closely adjacent. It is a well-recognised fact that, on the average, mosquitos take up a relatively greater concentration of microfilariae than is to be found in finger-prick blood [*cf.* **25** 237]. Evidence suggests that this is due to the actual concentration of microfilariae in the particular capillary on which the mosquito has fed and not to a chemotropism [*cf.* **20** 169] or to any mechanical power of the proboscis to "entangle" microfilariae [*cf.* **25** 238]. High counts are explained by the stagnation of other filariae in the smaller capillaries, since the experiments showed that it is from such small capillaries that a mosquito most often feeds. Moreover, as suggested above, blood corpuscles may escape more readily than microfilariae from capillaries lacerated by pricking.

Bertram (D. S.) & Gordon (R. M.). **An Insectarium with constant Temperature and Humidity Control; together with a Description of a simplified Technique for the rearing of** *Anopheles maculipennis* **var.** *atroparvus*.—*Ann. trop. Med. Parasit.* **33** no. 3–4 pp. 279–288, 2 figs., 3 charts, 1 ref. Liverpool, 1939.

Detailed descriptions are given of the construction and equipment of an insectarium recently built at the Liverpool School of Tropical Medicine, in which the moisture is supplied by two humidifiers regulated by a humidity control apparatus and heat by electric heaters provided with thermostats. Drum records of temperature and humidity kept from April to July 1939 showed that it was impossible to maintain a constant temperature without the use of blinds, since sudden rises in temperature of as much as 5°C. [9°F.] occurred on sunny days even in early summer. It was possible to maintain constantly a relative humidity of between 75 and 85 per cent., so long as reasonable precautions were taken to see that the door of the insectarium was not left open unnecessarily. The insectarium has been in use for 18 months, and satisfactory results have been obtained in rearing various Arthropods.

A description is also given of the technique devised by M. Bates and successfully used by the author for rearing *Anopheles maculipennis*, Mg., race *atroparvus*, van Thiel [*cf. R.A.E.*, B **28** 85]. The stock food-supply for the larvae consists of two parts mud to one part water, and this is diluted for use with rather more than an equal quantity of water. For a newly hatched larva, the optimum food-supply is 1 cc. of this mixture on which fine dried bread crumbs are dusted daily. When rearing is carried out at 22–24°C. [71·6–75·2°F.], the larvae should be well on in the second instar in about 4–5 days, when they should be transferred to larger dishes and allowed 2 cc. of the mud and water mixture. They are transferred to still larger dishes when they reach the fourth instar (4–5 days later)

and are allowed 5 cc. of the mixture. Finely sieved bread crumbs should be dusted daily on all pans containing larvae. Bates considers that the increase of surface area per larva is of more importance than any increase in the depth of the fluid. The depth of mud and water recommended by him is about 2 inches, but 1 inch has been found to be sufficient. This technique gave results as good as those obtained with the method recommended by Shute [*cf.* **25** 43] and has the advantage of saving space in the room and time in collecting pupae. It was found, however, that the stock mixtures of mud and water did not keep indefinitely. To overcome the necessity for repeated visits to the source of suitable earth, which was at some distance, and to avoid the variation in the nature of the soil that occurred at different times of the year, earth was dried in a warm room, sieved and stored in jars, which were then sterilised in a hot air oven at 160°C. [320° F.] for 20 minutes on two successive days. When required for use, 9 parts of the prepared earth are mixed with 50 parts of rain-water (Liverpool tap-water was equally satisfactory). The particles that float to the surface when the mixture is allowed to settle are skimmed off, because when they are present in quantity they appear to inhibit proper development of the larvae. The resultant mixture forms the first breeding medium of the growing larvae. At intervals, as recommended, additional mixture is prepared in a suitable dish and the larvae together with the original medium are transferred to it. The excellent results obtained with Bates' technique were repeated with this one, and there was no difficulty in rearing stocks of large, healthy adults.

GENEVRAY (J.), TOUMANOFF (C.) & H[OANG]-T[ICH]-TRY. **Résultats d'une enquête sur le paludisme à Hanoi.**—*Rev. méd. franç. Extr.-Orient* **17** no. 8 pp. 963–974, 1 map, 15 refs. Hanoi, 1939.

In view of the occurrence in Hanoi of cases of malaria contracted locally, malaria and mosquito surveys of the town were undertaken simultaneously in 1939 to determine the exact status of the disease. It was found that the distribution of malaria is very uneven ; the centre of the town is completely free, and foci are found only at certain points on the periphery and at Banc de Sable, which runs along the edge of the Red River. Even in the foci, the endemic indices are very low ; Banc de Sable may be said to be the only focus of any importance and there the average parasite rate was only 1·52 and the spleen rate 0·36. The 4,289 Anopheline larvae collected in different parts of the town comprised examples of *A. hyrcanus* var. *sinensis*, Wied., *A. vagus*, Dön., *A. barbirostris*, Wulp, *A. philippinensis*, Ludl., *A. annularis*, Wulp (*fuliginosus*, Giles), and *A. aconitus*, Dön., and the 619 adults caught in houses examples of *A. h. hyrcanus* and *A. h. nigerrimus*, Giles, *A. vagus*, *A. kochi*, Dön., and *A. tessellatus*, Theo. Dissection revealed no infections either of the stomach or the salivary glands. *A. vagus* was the most numerous species (77·89 per cent.) followed by *A. h. sinensis* (20·49 per cent.). No efficient vectors were discovered, though a single example of *A. jeyporiensis*, James, which had probably been brought down from the high region in a sampan, was taken in a dwelling at Banc de Sable.

Banc de Sable is a regular port of call for the sampans of merchants coming from the high region, particularly Hoà-Binh, and it is probable that malaria is constantly being introduced into this quarter by persons infected elsewhere. It may possibly be sometimes transmitted

by efficient vectors, such as *A. minimus*, Theo., and *A. jeyporiensis*, also introduced from elsewhere, but most of the local infection must be transmitted by local Anophelines, and this presupposes intense breeding, as they are poor vectors. The conditions necessary for intense breeding are present at Banc de Sable, since the dwellings are at all times surrounded by streams fed either by rain or by the river. At times of flood the river covers the ground surrounding the settlements, and the marshes left when it subsides, together with the borrow pits dug along its banks, form breeding places sufficiently extensive to ensure abundant breeding. The absence of cattle increases the contact between mosquitos and man, and the poverty and unhealthy surroundings of the population increase their susceptibility to infection. Similar factors are at work in the small suburban foci, and, at times of intense breeding, infected mosquitos may succeed in infecting susceptible individuals even in the centre of the town.

The problem of control, which is complex, is briefly discussed. The usual measures such as clearing, oiling and the administration of drugs are of value, but are only palliative. Permanent measures, such as drainage and filling, are costly and can only be carried out gradually ; moreover, they cannot be effective in the flood zone where Banc de Sable is situated. It is suggested that the most satisfactory way of dealing with the problem in this quarter would be to remove the population to a more healthy locality, since it is a constant danger to the rest of the town.

MESNARD (J.) & TOUMANOFF (C.). **Au sujet du rôle joué par** *Stomoxys calcitrans* **dans la transmission de** *Trypanosoma annamense*, **Laveran.**—*Rev. méd. franç. Extr.-Orient* **17** no. 8 pp. 995–999, 4 refs. Hanoi, 1939.

After briefly reviewing the literature on the transmission of surra by *Stomoxys calcitrans*, L., the authors state that they have carried out experiments in which reared examples of this fly were fed for 5–6 days on a guineapig infected with *Trypanosoma annamense* (the causal organism of surra in Indo-China, where it is fairly common among domestic buffalos and oxen) and then daily for 12–30 days on a healthy guineapig. Details of several of the experiments are given. The guineapigs all remained healthy during the period for which they were kept under observation (about 3 months). Thus, if the trypanosome undergoes development in the fly, it must take longer than was supposed, or the incubation period of surra in guineapigs infected under these conditions is particularly long. An account is also given of an experiment in which the infection was transmitted mechanically from an infected to a healthy guineapig by the interrupted feeding of a single fly. Further experiments will show whether this is the usual mode of transmission, but even if it is exceptional experimentally, it may still be of importance in nature in view of the abundance of the fly in the vicinity of cattle.

TOUMANOFF (C.). **Recherches sur la transmission de la filariose canine à** *Dirofilaria immitis* **au Tonkin.**—*Rev. méd. franç. Extr.-Orient.* **17** no. 8 pp. 1000–1015, 2 figs., 8 refs. Hanoi, 1939.

An account is given of experiments carried out in Tonkin on the development of *Filaria* (*Dirofilaria*) *immitis* in *Aëdes* (*Stegomyia*) *aegypti*, L. (*fasciatus*, F.), *A albopictus*, Skuse, *Anopheles vagus*, Dön.,

A. hyrcanus var. *sinensis*, Wied., and *Culex fatigans*, Wied., after they had fed on a heavily infected dog. In experiments with *A. aegypti* and *A. albopictus*, about 64 per cent. died within 10 days after the infecting feed, and of those remaining, about 30 per cent. became infected in summer and about 10 and 2 per cent., respectively, in winter. Proboscis infection, which was observed only in the hot rainy season, occurred 11–35 days after the infecting feed in 14·42 and 11·76 per cent. of the two species, respectively. Although only small numbers of the other three species were used, the experiments showed that *F. immitis* could complete its development in all of them. The results of precipitin tests on 16 species of Anophelines collected in southern and northern Indo-China and in Hong Kong are recorded and show that, in areas where cattle are abundant, reactions to anti-dog sera are few. Precipitin tests on the five species of mosquitos mentioned above, collected in a locality where only men, horses and dogs were present, showed that all had fed on dogs in considerable numbers. Thus, it would appear that many species of mosquitos may act as vectors of *F. immitis* in Tonkin, and if one species appears to be more important than another, this is attributable to circumstances favouring its contact with the local canine population.

VENHUIS (W. G.). **The hyrcanus Problem in the Netherlands East Indies, with Description of a widespread Malaria carrying Variety: *An. hyrcanus X*. (First Communication).**—*Meded. Dienst Volksgezondh. Ned.-Ind.* **28** no. 4 pp. 376–389, 2 pls., 2 figs., 22 refs. Batavia, 1939. Also in Dutch in *Geneesk. Tijdschr. Ned.-Ind.* **80** pt. 1 pp. 27–43, 4 pls., 23 refs. Batavia, 1940.

Examination of some pupal pelts of *Anopheles hyrcanus*, Pall., from Java led the author to conclude that they did not belong either to var. *sinensis*, Wied., or var. *nigerrimus*, Giles. A number of larval and pupal pelts with the corresponding adults were, therefore, obtained by rearing from several places on Java and Celebes, and nearly all belonged to the new variety, which is provisionally named *A. hyrcanus X*. since it may possibly not be a single entity. Characters are given distinguishing it from var. *sinensis* in all stages and from var. *nigerrimus* in all except the egg. Some constant differences between specimens from Java and Celebes indicate that it may consist of more than one race or variety, and larvae from south-eastern Borneo and Poelau Laoet, which resembled it, could be distinguished by certain characters. It closely resembles var. *williamsoni*, Baisas & Hu [*R.A.E.*, B **26** 201], but there are some differences in the larva and pupa, and until the adult and egg of this variety are described and a full description of the larva is available, it will be impossible to decide whether or not they are identical. No examples of var. *sinensis* and only a few larvae attributable to var. *nigerrimus* were found among material from Java, but both were observed among material from one locality on Celebes. During a malaria epidemic at Benteng, Celebes, 54 out of 587 Anophelines resembling *A. hyrcanus* were infected, together with 60 out of 524 females of *A. barbirostris*, Wulp. Examination of 63 sets of larval and pupal pelts with the corresponding adults obtained from Benteng at the time showed that all were *A. hyrcanus X*; moreover about 6 larvae and 160 adults of *A. hyrcanus* from the same place were also examined, and no examples of either var. *sinensis* or var. *nigerrimus* were discovered. During an

epidemic at Karangbinangoen, Java, 46 out of 466 Anophelines resembling *A. hyrcanus* were infected ; many hundreds of larvae and adults and about 50 sets of pelts and adults were examined and all were *A. hyrcanus X*. In a restricted part of the epidemic area, 15 out of 32 females of *A. aconitus*, Dön., were infected, but as this mosquito was absent elsewhere, *A. hyrcanus X* would appear to have been the important vector.

Venhuis (W. G.). **Een nieuwe Anopheleslarve uit Indochina** *Anopheles alongensis* **nov. sp.** [A new *Anopheles* Larva from Indo-China.]—*Geneesk. Tijdschr. Ned.-Ind.* **80** pt. 3 pp. 173–178, 2 pls. Batavia, 1940. (With a Summary in English.)

A detailed description is given of the larva of *Anopheles alongensis*, sp. n., six examples of which were taken in clear fresh water in a stalactite cave in the cliffs a few miles from the shore of the Bay of Along, Tonkin.

Roubaud (E.) & Treillard (M.). **Diversités biologiques et différenciations raciales chez l'***Anopheles claviger* **Mg.** (*bifurcatus*).—*Bull. Soc. Path. exot.* **33** no. 1 pp. 21–25, 5 refs. Paris, 1940.

The authors describe experiments which show that although a strain of *Anopheles claviger*, Mg., from Toulon was successfully reared through several generations in small cages, one from the district of Morvan could not be induced to pair, even if rather larger cages were used. Moreover, although it is generally accepted that this species hibernates in the larval stage, the strain from Toulon showed no tendency to enter a diapause from the time active larvae were collected at the end of December. The Morvan strain exhibited a period of latency as full grown larvae within the egg ; a number of eggs that failed to hatch after the normal incubation period of 2 days hatched 17–18 and 23 days later. Larvae that hatched from these eggs developed normally without a diapause and reached the adult stage in November–December, so that it appears that the delay in hatching took the place of a diapause in the larval stage. No such delay in hatching was observed among the eggs of the Toulon strain.

Blanc (G.) & Baltazard (M.). **Longévité du virus de typhus murin dans les déjections de puces infectées.**—*Bull. Soc. Path. exot.* **33** no. 1 pp. 25–32, 6 graphs, 11 refs. Paris, 1940.

Further investigations [*cf. R.A.E.*, B **25** 157] have shown that the virus of murine typhus remains viable in dried excreta of infected fleas for 651 days. The minimum dose that is certain to infect man has been shown to be 0·01 mg. ; this dosage, which, when the dried virus was recently collected, infected 100 per cent. of the persons inoculated and gave only 10 per cent. of inapparent infections, was used in tests on the survival of the virus. Such a test of the dried virus 651 days old indicated that it was as active as when it was first obtained. The virus conserved in excreta is stable and can be used for the preparation of vaccine for at least two years without frequent experiments to test its virulence. The highly infectious nature of the viruses of epidemic and murine typhus, the possibility of their diffusion in

dust and their penetration of the mucous membranes, their non-transmissibility by the bites of their insect vectors (which has been proved in the case of murine typhus [*cf.* **26** 90] and is very probable in the case of epidemic typhus) and their survival under natural conditions for periods longer than the inter-epidemic intervals suggest the need for a revision of ideas concerning the epidemiology of these diseases. The long survival of the virus in excreta explains the endemicity of epidemic typhus and the transportation of the virus in the absence of lice [*Pediculus humanus*, L.].

Wu (Chao-jen) & Zia (S. H.). **Isolation of Typhus Fever Virus from House Rats in Peiping.**—*Proc. Soc. exp. Biol. Med.* **39** no. 1 pp. 163–165, 6 refs. New York, 1938.

Liu (W. T.) & Chung (H. L.). **Typhus Virus isolated from Rats and Rat-fleas in Typhus Houses.**—*Op. cit.* **40** no. 3 pp. 353–355, 3 refs. 1939.

It is stated in the first paper that a strain of typhus virus was obtained from one batch of three out of 139 rats taken in houses in Peiping. The rats of the infected batch were taken in March 1938.

In the second paper are recorded observations in 1938 on two strains of the virus isolated from rats and three from batches of rat-fleas taken in Peiping in the houses of two persons considered to be suffering from murine typhus. Of the 14 fleas taken, the only one identified was *Xenopsylla cheopis*, Roths.

Blanc (G.), Martin (L.-A.) & Baltazard (M.). **Comportement du virus de typhus murin chez le pou de l'âne,** *Haematopinus asini* **(Lin.).**—*C. R. Acad. Sci.* **209** no. 12 pp. 492–493, 1 ref. Paris, 1939.

The results are given of experiments in which murine typhus was transmitted to guinea-pigs by the intraperitoneal injection of suspensions of lice (*Haematopinus asini*, L.) that had fed on an infected donkey. Transmission was first effected 10 days after the donkey had been inoculated with the virus, when it no longer showed symptoms of the disease, and lice taken from it during a period of over 10 days were infected. The incubation period in the guineapigs was shorter than that following the inoculation of blood from the infected donkey, which often resulted in no apparent symptoms; it is therefore concluded that the rickettsiae had multiplied in the louse. The disease was transmitted to man in four instances by the injection of excreta of the infected lice. Eggs of the louse were not infective.

Bonjean (M.) & Charnot (A.). **La désinsectisation rapide des vêtements par l'acide cyanhydrique.**—*Bull. Inst. Hyg. Maroc* 1939 no. 1–2 pp. 5–11, 6 pls. Rabat, 1939.

The authors describe in detail three types of apparatus that have been found satisfactory for the rapid destruction of lice [*Pediculus humanus*, L.] on clothing by means of hydrocyanic acid gas, and the procedure followed in carrying out the fumigation. Experiments, details of which are to be published elsewhere, indicated that the concentrations of gas necessary to procure satisfactory results are higher than those indicated by other authors. As the percentage of

lice killed was considerably lower when the temperature was low, steps were taken to heat the fumigation chambers when necessary and carbon dioxide was liberated with the hydrocyanic acid gas in order to stimulate the respiration of the lice. The three types of apparatus were a series of gas-proof chambers built of masonry for use in towns, two gas-proof wooden chambers fitting one inside the other that could be carried on a lorry, and a gas-proof van. In all types, the equipment comprised an absolutely gas-proof chamber, an oil stove for heating, a rack for holding the clothes, a device for generating the two gases, an apparatus for ventilating purposes, a means of neutralising the gas-producing mixture after fumigation, masks and overalls for protecting the personnel and a special first-aid box, the contents of which are listed. The two gases are generated within the gas-proof chambers by allowing a concentrated solution of sulphuric acid (1,254 gm. per litre) to react with a solution of sodium cyanide (about 475 gm. per litre, titrating 233 gm. HCN per litre) to which has been added a saturated solution of sodium carbonate (Solvay). These solutions were used at rates of 40, 88 and 27 cc., respectively, per cubic metre. As the sodium cyanide solution does not keep well, it should not be prepared more than 8–10 days in advance. Exposure of the lice under these conditions should last 20 minutes.

Buxton (P. A.). **The Louse: Present Knowledge and Future Work.**—*Trans. R. Soc. trop. Med. Hyg.* **33** no. 4 pp. 365–379, 1 fig., 13 refs. London, 1940.

The author briefly discusses the biology of populations of *Pediculus humanus*, L. (including race *capitis*, DeG.) on man and the measures that may be taken for the control of this species and *Phthirus pubis*, L., the information being taken from his recent book [*R.A.E.*, B **27** 252].

Sokhey (S. S.), Chitre (G. D.) & Gokhale (S. K.). **The Relative Value of some Proprietary Cyanide Preparations for the Extermination of Rats and Fleas as a Plague-preventive Measure.**—*Indian J. med. Res.* **27** no. 2 pp. 389–407, 1 diagr. Calcutta, 1939.

An account is given of experiments in which three proprietary calcium cyanide preparations, Calcid Briquettes, Cyanogas A Dust and Cymag, were tested to determine their relative value for the extermination of rats and fleas under Indian conditions.

Anderson (W. M. E.). **Observations on *P. papatasii* in the Peshawar District. Part I.**—*Indian J. med. Res.* **27** no. 2 pp. 537–548, 10 refs. Calcutta, 1939.

An account is given of investigations carried out in 1938 on various points connected with the transmission and control of sandfly fever, which is very prevalent during the hot weather among troops in Peshawar and adjoining areas in the North-West Frontier Province [*cf. R.A.E.*, B **14** 146]. *Phlebotomus papatasii*, Scop., which is the vector, is apparently capable of flying as high as 70 ft. above the ground, and no evidence could be obtained that persons sleeping in upper storeys were in any way less exposed to attack. The minimum

wind velocity against which *P. papatasii* in flight can make no progress seems to be about 1·8 miles per hour. It is pointed out that, of the preventive measures in force, few are of greater importance than the proper supervision of unoccupied buildings. Ruined buildings, especially those of mud, invariably contain large numbers of cracks and fissures that form potential breeding places for sandflies, and if they are in the vicinity of occupied premises, they should either be demolished or very thoroughly renovated. Moreover, cracks are liable to develop in unoccupied buildings that are otherwise in a fair state of repair. A solution of naphthalene in kerosene applied to as many potential breeding places as possible within 120 yards of an isolated building failed to effect any material reduction in the sandfly population. A 5 per cent. solution in kerosene of lethane 384 [a commercial preparation consisting of equal parts by volume of *n*-butyl-carbitol-thiocyanate and a highly refined petroleum distillate] applied by means of a Phantomyst atomiser appeared to be effective in eliminating *P. papatasii* from a barrack room for more than 12 hours. As living sandflies placed in cages near the atomiser were killed, the solution would appear to be of insecticidal value and not merely to act as a repellent.

Sacca (G.). **Osservazioni su un esemplare di** *Phlebotomus parroti* **raccolto a S. Felice Circeo.** [Observations on an Example of *P. parroti* collected at S. Felice Circeo.]—*Ricerca scient.* **10** no. 11 pp. 1037–1038, 3 figs., 7 refs. Rome, 1939.

A description is given of a male of *Phlebotomus parroti*, Adl. & Thdr., taken at S. Felice Circeo, on the Italian coast to the south of the Pontine Marshes. *P. parroti* had not previously been recorded from central Italy. The author states that the description agrees with that of var. *italicus*, Adl. & Thdr. [*R.A.E.*, B **19** 121], but as the latter was described with the number of teeth on the buccal armature of the female as the only definite differential character, he does not consider it to be valid [*cf.* **28** 69].

Vanni (V.). **Epidemiologia, trasmissione e profilassi della Leishmaniosi cutanea in Italia.** [The Epidemiology, Transmission and Prophylaxis of Cutaneous Leishmaniasis in Italy.]—*Ann. Igiene* **50** no. 2 pp. 49–58, 4 figs., 13 refs. Rome, 1940.

In continuation of his work on sandflies (*Phlebotomus*) and cutaneous leishmaniasis in Italy, which indicated that *P. perfiliewi*, Parr., is a vector in the Province of Teramo, Abruzzi [*R.A.E.*, B **27** 62, 165], the author has extended his investigations to other provinces. In the province of Forlì, on the Adriatic coast, the disease occurs near rivers and streams in rural districts up to about 1,300 ft. All the cases occurred in dwellings above animal quarters with manure heaped against the wall of the building. No sandflies were seen by day, but at twilight and throughout the night they attacked man, especially persons approaching the houses. At night they were easy to find in the dwelling rooms, and about 100 could be taken in half an hour in the stables below. They were abundant in dilapidated, dirty stables, and preferred stables containing oxen to those containing other

animals. As none was found in a damp, dark cellar or in two underground stores containing rotted timber, it is considered that domestic animals, especially cattle, attract the fertilised females. None was found in a stable containing horses exclusively, or in one that contained cattle and horses, but was kept scrupulously clean, with varnished beams and mangers, and smooth, whitewashed walls. In one locality, sandflies were taken in small numbers in a stable containing sheep, and were numerous in an adjacent stable containing cattle. The species found in Forlì were *P. perfiliewi*, which predominated, *P. major*, Annan., and *P. papatasii*, Scop., which was rare.

In the province of Teramo [*cf.* **27** 62], the disease occurred from sea-level up to about 1,300 ft., and manure heaps adjoined the houses. Sandfly pupae were found in the compost round the heaps, and it is probable that the heat of fermentation permits the overwintering pupae and the fourth-instar larvae to survive from one year to another.

In the province of Pescara, cases occurred only at Manoppello and Alanno Scalo. In the former locality, sandflies were common and one example of *P. papatasii* and many of *P. perfiliewi* were taken in a few minutes in a house in which were four cases of the disease; the adjoining stable contained sheep and pigs. At Alanno Scalo, where the disease has been common for years and where cases of visceral leishmaniasis have also been recorded, *P. major* predominated over *P. perfiliewi* and *P. perniciosus*, which has been suspected of being a vector of visceral leishmaniasis in Sicily [**19** 218]. It was remarkable that the sandflies were absent from stables, but were abundant in dwellings and shops, especially on shiny white surfaces, and attacked man eagerly. It is concluded from these observations that sandflies in Italy need a moist environment with a high temperature and are at their maximum vitality only at the height of summer. No cases of cutaneous leishmaniasis occur above about 1,300 ft., as the sandflies do not bite at a low temperature or when there is even slight movement of the air.

The province of Campobasso is practically free from the disease, and no cases were observed at altitudes between about 1,600 and 2,500 ft. In one locality, *P. major* and *P. perfiliewi* were taken in small numbers in a stable containing cattle. In this province, manure heaps are kept about 100 yds. away from the houses, and the inhabitants are rarely bitten. It is therefore concluded that under certain conditions and at low temperatures, the sandflies are attracted to cattle rather than to man.

The author gives a brief account of the way in which he considers that the disease is transmitted. The sandflies have a maximum flight radius of 100–200 yds. They pair in the open, and the fertilised females are attracted to cattle, on which they feed, chiefly at dusk. When engorged they tend to fly upwards, are attracted by the light in the dwelling room (which is almost always above the stable) and bite man. If the man is asleep, the sandfly completes its meal and regurgitates the infective flagellates of *Leishmania tropica* into the puncture in the skin. Beds should therefore be screened. Infection does not occur if the man is awake, as the sandfly is driven away before regurgitation. The author and his assistants were bitten many times in two years, when awake, in the infested localities and did not contract the disease. Having sucked blood, the female oviposits on the compost or on the surface of the manure heap, where the heat of fermentation favours the development of the larvae and pupae.

SANGIORGI (G.) & ATTIMONELLI (R.). **Saggi sul valore pratico di un nuovo mezzo moschicida.** [Experiments on the practical Value of a new Fly Insecticide.]—*Ann. Igiene* **50** no. 2. pp. 67–69. Rome, 1940.

A proprietary mixture of whey and arsenic, diluted with water to make a bait-spray, has been found highly effective in Italy against adults of *Musca domestica*, L., both in laboratory tests and when sprayed on rubbish dumps and manure heaps, or on sheets of cloth hung near them. The attractiveness and toxicity of a coating of the mixture that has dried can be restored by moistening it.

DELBUE (A.). **Un esperimento di lotta contro le mosche a Valeggio sul Mincio.** [An Experiment in Fly Control at Valeggio on the Mincio.]—*Ann. Igiene* **50** no. 2 pp. 70–78. Rome, 1940.

An account is given of a successful campaign carried out in 1938 and 1939 against flies [chiefly *Musca domestica*, L.] at Valeggio, a small town in North Italy. The work included the organised collection of refuse, the storage of manure in cement pits, and the destruction of flies by means of a poison bait and by collection in winter, 300,000 being caught by boys in January and February. The bait-spray consisted of a mixture of 4 lb. beet molasses and 1 lb. sodium arsenite diluted with water to make 5 gals. ; it was sprayed on manure and on bundles of twigs hung up in places frequented by flies. A considerable reduction in the fly population was attained.

SILVESTRI (F.). **Compendio di Entomologia applicata (agraria-forestale-medica-veterinaria. Parte speciale, Vol. I (parte 2a)** pp. 449–974, 464 figs., 58 pp. refs. Portici, 1939.

This second part of the first volume of this work [*R.A.E.*, A **23** 296] deals with the Aphids not included in the previous part, the Coccids and the Anoplura.

DESPORTES (C.) & HARANT (H.). **Observations sur la biologie d'un cératopogoniné hématophage,** *Forcipomyia velox* **Winn. 1852, piqueur de la grenouille verte.**—*Ann. parasit. hum. comp.* **17** no. 5 pp. 369–374, 10 refs. Paris, 1940.

Lasiohelea (*Forcipomyia*) *velox*, Winn., the female of which is described, was observed at Richelieu (Indre-et-Loire) to suck the blood of green frogs (*Rana esculenta*). Under certain conditions it also fed on other batrachians, but it did not attack man or reptiles.

BRUCE (W. G.). **The Use of Phenothiazine in the Medication of Cattle for the Control of Hornflies.**—*J. econ. Ent.* **32** no. 5 pp. 704–706, 2 refs. Menasha, Wis., 1940.

The following is substantially the author's summary : Experiments were conducted to determine the value of phenothiazine [thiodiphenylamine] in preventing the development of the larvae of *Lyperosia* (*Haematobia*) *irritans*, L., in cattle droppings [*cf.* *R.A.E.*, B **26** 197]. When various quantities of the chemical mixed with bran were fed to cattle, the minimum dose that killed all the larvae was 22 milligrams per kilogram of body weight of the animal. This dose rendered the droppings unfavourable for the development of the

larvae for approximately 24 hours, beginning 12 hours after administration. When phenothiazine was mixed directly with the droppings, the minimum lethal dose was 4 milligrams for each 100 grams of the droppings.

LENT (H.) & PIFANO C. (F.). *Eutriatoma nigromaculata* **(Stål, 1872) n. comb., especie venezuelana encontrada infestada pelo** *Schizotrypanum cruzi* **(Chagas, 1909). Nota prévia.**—*Brasil-Medico* **53** no. 27 pp. 685–686, 1 ref. Rio de Janeiro, 1939.

The authors record the finding in the State of Yaracuy, Venezuela, of *Triatoma* (*Eutriatoma*) *nigromaculata*, Stål, which had not been observed since it was first taken at La Guayra in 1859. It was naturally infected with *Trypanosoma* (*Schizotrypanum*) *cruzi*. The other Triatomids that have been found naturally infected in Venezuela are *Rhodnius prolixus*, Stål [*cf. R.A.E.*, B **8** 16], *Eratyrus cuspidatus*, Stål [**22** 145] and *Triatoma* (*Eutriatoma*) *maculata*, Erichs. [**27** 94]. Two species occurring in Venezuela that have been found naturally infected in other countries are *Mestor* (*Panstrongylus*) *geniculatus*, Latr. [**20** 94] and *Triatoma dimidiata*, Latr. [**23** 41 ; **24** 270]. The only other Triatomids that have been recorded in Venezuela are *T. rubrofasciata*, DeG., *Belminus rugulosus*, Stål, *Rhodnius pictipes*, Stål, and *Psammolestes arthuri*, Pinto.

PESSOA (S. B.) & DE BARROS (N. V.). **Creação do** *Triatoma infestans* **na temperatura de estufa.** [Rearing of *Triatoma infestans* at the Temperature of the Incubator.]—*Folha med.* **20** no. 18 pp. 285–287, 4 refs. Rio de Janeiro, 1939.

It is necessary to rear large numbers of Triatomids for the xenodiagnosis of Chagas' disease [caused by *Trypanosoma cruzi*] and for this purpose nymphs of the fourth and fifth instars are the most satisfactory. In São Paulo, *Triatoma infestans*, Klug, is the commonest species, but it has never been possible to rear it from egg to adult at room temperature in the laboratory in less than 300 days. Experiments were therefore undertaken in which eggs were kept at room temperature until they hatched, and some of the resulting nymphs were reared at room temperature while others were kept in an incubator at 37°C. [98·6°F.]. All were fed once or twice a week on guineapigs.

The results showed that the development from hatching to adult of those in the incubator took about half the time required by those kept at room temperature ; the minimum and maximum periods for the former were 94 and 114 days, respectively. It is recommended that when nymphs that are being reared in the incubator have reached the fifth instar they should be removed to avoid the heavy mortality caused by high temperatures. In certain individuals reared in the incubator development ceased in the fifth instar, and further experiments will be necessary to determine the cause of this behaviour.

HOFFMANN (W. H.). **Experiencias biológicas sobre los triatomas de Cuba.**—*Rev. Med. trop. Paras.* **5** no. 5 pp. 267–272. Havana, 1939.

In view of the fact that laboratory investigations have shown that *Triatoma flavida*, Neiva, is able to transmit *Trypanosoma* (*Schizotrypanum*) *cruzi*, the causal agent of Chagas' disease, the author records observations made in Cuba over a number of years on the

life-history and habits of this Triatomid [*cf. R.A.E.*, B **11** 167; **14** 74], all stages of which are briefly described. It is restricted to Cuba and is rare. It has not yet become domesticated, and it is believed to live in the caves of wild animals, on which it feeds, particularly in the burrows of rodents and possibly iguanas. It occasionally enters houses at night. It does not appear well adapted to human blood, and cultures fed on man died out in the second generation, as no fertile eggs were deposited. Normally females laid 2–10 eggs daily, and viable eggs were obtained for 3–4 months after a single fertilisation. The egg and nymphal stages lasted 2–3 weeks and 19–31 months, depending on conditions of nutrition. While feeding the nymphs on himself, the author observed that occasionally an individual that was unable to penetrate the skin would suck blood from the abdomen of an engorged nymph nearby. No trypanosomes were observed in the excreta of the bugs, and so far as the author is aware, Chagas' disease has not been reported from Cuba.

KRULL (W. H.). **On the Life History of *Moniezia expansa* and *Cittotaenia* sp. (Cestoda: Anoplocephalidae).**—*Proc. helminth. Soc. Wash.* **6** no. 1 pp. 10–11. Washington, D.C., 1939.

A summary is given of the results of an investigation on the life-cycles of the common sheep tapeworm, *Moniezia expansa* and one of the rabbit tapeworms, *Cittotaenia* sp., carried out in Maryland from July 1936 to July 1938. Attempts to infect invertebrates commonly found on pastures and in wet or moist places to which animals serving as hosts for Anoplocephaline tapeworms had access gave negative results. After it was reported that the development of the worms took place in Oribatid mites [*cf. R.A.E.*, B **28** 51], experiments were undertaken to confirm this finding. A survey of the Oribatids occurring on pastures under various conditions revealed the presence of more than 20 species. They were generally distributed, the number on grass at any particular time depending largely on weather conditions; drought or prolonged wet periods did not appreciably reduce the number in a given area. They were collected from grass exposed to temperatures below freezing and from grass beneath snow. They were more numerous during spring than during winter, the maximum number being found at the time the new growth of grass appeared. They were most numerous during the first hours of daylight following rain sufficiently heavy to soak the ground; they were also abundant on cloudy days after a soaking rain. It is estimated that under favourable conditions a grazing sheep may ingest more than 1,200 mites per pound of grass.

Of the 20 species of Oribatid mites obtained, only one, *Galumna emarginata*, Banks, was found to be infected with cysticercoids. This mite was one of the largest species and was widely distributed. It was collected from pastures throughout the year, but was never numerous; it constituted only 586 out of 11,310 Oribatids collected. The cysticercoids were recovered from it in April, May and November. Out of 286 specimens examined in April and May, only 5 harboured cysticercoids. The 5 cysticercoids were dissected from the mites and fed to a 2-months-old lamb between 11th and 28th May. Two examples of *Moniezia expansa* (99 and 2·75 ins. long) were recovered from the lamb, which was killed on 13th June [**27** 145]; none was found in its twin, which was used as a control. Both lambs had been reared under conditions precluding any possibility of extraneous

infection ; moreover, other lambs reared under similar conditions during previous years had also remained free from tapeworms. Attempts to infect a wild rabbit by feeding it on Oribatid mites collected from grass from areas contaminated with the faeces of wild rabbits were unsuccessful, but 3 out of 5 domestic rabbits became infected with *Cittotaenia* after being kept on a plot in which *Galumna emarginata* was present ; each infested rabbit harboured 2 immature tapeworms.

PAPERS NOTICED BY TITLE ONLY.

HOFFMANN (W. H.). **La fiebre amarilla selvática** [Jungle yellow Fever (a review of present knowledge)].—*Rev. Med. trop. Paras.* **5** no. 5 pp. 257–265. Havana, 1939.

SENEVET (G.) & ABONNENC (E.). **Les moustiques de la Guyane.—V Les genres** *Mansonia, Orthopodomyia, Aëdomyia, Psorophora, Uranotaenia* [including keys to adults and larvae].—*Arch. Inst. Pasteur Algérie* **17** no. 4 pp. 585–597, 6 figs. Algiers, 1939. [*Cf. R.A.E.*, B **28** 80.]

PARROT (L.) & CLASTRIER (J.). **Notes sur les phlébotomes. XXXI.—Présence de** *Phlebotomus ariasi* **Tonnoir sur le littoral algérien.**—*Arch. Inst. Pasteur Algérie* **17** no. 4 p. 633, 2 refs. Algiers, 1939. [*Cf. R.A.E.*, B **24** 168, 312.]

LAVIER (G.) & RISTORCELLI (A.). **Présence en Seine-et-Marne de** *Phlebotomus larroussei*.—*Ann. Parasit. hum. comp.* **17** no. 5 pp. 375–379, 1 pl., 2 figs., 11 refs. Paris, 1940.

VAZ (Z.) & TEIXEIRA DE CARVALHO (G.). **Sobre um tipo interessante de miíase dos bezerros e seu agente causal.** [A curious Type of Myiasis of the Mouth in Young Calves due to *Cochliomyia hominivorax*, Coq.]—*Rev. Fac. Med. vet., S. Paulo* **1** pp. 43–48, 4 figs., 4 refs. 1938. (With a Summary in English.) (Abstr. in *Vet. Bull.* **10** no. 3 pp. 178–179. Weybridge, 1940.)

ŌMORI (N.). **Experimental Studies on the Cohabitation and Crossing of Two Species of Bed-bugs** (*Cimex lectularius* **L. and** *C. hemipterus* **F.) and on the Effects of Interchanging of Males of one Species for the other, every alternate Days, upon the Fecundity and Longevity of Females of each Species.**—*Acta jap. Med. trop.* **1** no. 2 pp. 127–154, 1 fldg table, 6 refs. Taihoku, 1939. [*Cf. R.A.E.*, B **28** 97.]

BARBER (H. G.). **A new Bat Bug** [*Cimex adjunctus*, sp. n.] **from the eastern United States (Hemiptera-Heteroptera : Cimicidae).**—*Proc. ent. Soc. Wash.* **41** no. 8 pp. 243–246, 2 figs. Washington, D.C., 1939.

CHANDLER (W. L.) & RUHE (L. S.). *Pneumonyssus caninum* **n. sp., a Mite from the Frontal Sinus of the Dog** [in Michigan].—*J. Parasit.* **26** no. 1 pp. 59–70, 18 figs., 9 refs. Lancaster, Pa., 1940.

TRAVIS (B. V.). **Tests of Soil Treatments for the Control of the Fire Ant,** *Solenopsis geminata* **(F.).**—*J. econ. Ent.* **32** no. 5 pp. 645–650, 4 refs. Menasha, Wis., 1939. [*See R.A.E.*, A **28** 355.]

TRAVIS (B. V.). **Poisoned-Bait Tests against the Fire Ant** [*Solenopsis geminata*, F.], **with special Reference to Thallium Sulfate and Thallium Acetate.**—*J. econ. Ent.* **32** no. 5 pp. 706–713, 2 figs., 6 refs. Menasha, Wis., 1939. [*See R.A.E.*, A **28** 361.]

BONÉ (G.). **Contribution à l'étude de la transmission de la fièvre récurrente tropicale (deuxième mémoire).**—*Ann. Soc. belge Méd. trop.* **19** no. 4 pp. 477–484, 12 refs. Brussels, 1939.

In continuation of his investigations on *Spirochaeta duttoni* [*cf.* *R.A.E.*, B **27** 111, 141], the author carried out experiments on its survival in Arthropods other than *Ornithodorus moubata*, Murr. Injection into healthy mice of suspensions of examples of *Argas reflexus*, F., that had previously fed on a mouse infected with *S. duttoni* and thereafter been kept at 30°C. [86°F.] showed that the spirochaetes were infective 4, 6 and 7 months later. The development of these ticks is slow and few showed any desire to feed a second time. Three examples that had fed on an infected mouse three months earlier and five that had fed six months earlier failed to transmit the infection when they fed on healthy mice. This result might be explained by the fact that ticks of the genus *Argas* do not excrete coxal fluid until after they have fed, so that it frequently does not come into contact with the skin of the animal. However, injection of coxal fluid collected from three of the infected ticks also failed to induce the infection. Two groups of ten nymphs of *Argas persicus*, Oken, fed 2 months earlier on an infected mouse were fed on mice, into which their coxal fluid was also injected, but no infection resulted. A batch of 25 larvae reared from eggs laid by infected ticks was injected into a healthy mouse, but failed to produce infection.

Injection into healthy mice of batches of 25 and 75 nymphs of *Rhipicephalus sanguineus*, Latr., infected as larvae 3 and 4 weeks earlier, respectively, gave negative results, but 3 out of 7 mice became infected after they had received injections of batches of 10–25 adults of this species infected as nymphs 2–3 months earlier. Adults from batches proved by injection to be infected failed to transmit the disease when fed on healthy mice, but these results are not considered conclusive, for mice cannot sustain more than one or two ticks at a time.

Injection into healthy mice of suspensions of a few larvae of *Cimex lectularius*, L., infected 1–2 days previously produced infection, but injection of bugs fed 3 or more days previously gave negative results. Examination of the stomach contents of these bugs indicated that the spirochaetes degenerate there more or less rapidly according to the temperature at which the bugs are kept; at 37°F. [98·6°F.] they were all motionless after 24 hours, whereas at 17°C. [62·6°F.] some were still mobile after 48 hours. Bed-bugs infected 1–3 days earlier failed to infect healthy mice on which they were fed.

Examples of *Melophagus ovinus*, L., that had received their first feed after emergence on an infected mouse were injected at intervals into healthy mice. A mouse receiving an injection after 2 days became infected, whereas those receiving injections after 3 and 7 days did not. Moreover, a mouse on which nine examples were fed on the 2nd and 3rd days after the infecting feed failed to become infected, as did also a rat on which ten infected examples had fed for 5 consecutive days.

JELLISON (W. L.). **The Burrowing Owl as a Host to the Argasid Tick, *Ornithodorus parkeri*.**—*Publ. Hlth Rep.* **55** no. 5 pp. 206-208, 4 refs. Washington, D.C., 1940.

Larvae, nymphs and adults of *Ornithodorus parkeri*, Cooley, which are known to infest small mammals, particularly burrowing rodents

[*cf.* *R.A.E.*, B **28** 28], usually engorge within half-an-hour and subsequently leave their host to take shelter in the nests and burrows, where they are sometimes found in considerable numbers. For this reason, infestations on small mammals are not often observed and, when they occur, seldom exceed a few immature specimens. In the State of Washington, in June 1939, 18 burrows and nests of the burrowing owl, *Speotyto cunicularia*, were examined for parasites [*cf.* **27** 205] and 9 were found to be infested with *O. parkeri*. The ticks were found from within a few feet of the opening to the limits of the burrows, but were most abundant close to the nests. The burrows were often 3–4 feet underground and 10–14 feet long. The most heavily infested burrow contained 491 ticks, and two others each contained over 300. Many of the ticks from nests containing fledglings were freshly engorged with avian blood. Though the infestations may have been initiated by ticks carried to the burrows on rodents, the extremely large numbers of ticks and the fact that they were feeding on the birds suggests that the owl is an accepted, if not the most important, host of *O. parkeri* in this area. As the owls are migratory, at least in the northern part of their range, they may be an important factor in the dispersion of the tick.

HIXSON (H.). **Biology, Host Relationship and Identification of Ticks infesting Dogs in Florida.**—*N. Amer. Vet.* **20** no. 7 pp. 45–50, 5 figs. 1939. (Abstr. in *Vet. Bull.* **10** no. 2 p. 98. Weybridge, 1940.)

Of the ticks that occur on dogs in Florida, *Rhipicephalus sanguineus*, Latr., is found throughout the year, *Ixodes ricinus scapularis*, Say, only in the winter months, *Dermacentor variabilis*, Say, in spring and early summer, and *Amblyomma americanum*, L., and *A. maculatum*, Koch, in summer. All stages of *R. sanguineus* attack dogs, but only the adults of the other four species.

CALZADA (V.). **Nueva comprobación de** *Ixodes ricinus* **en el país.** [*Ixodes ricinus* **in Uruguay.**]—*Bol. mens Direcc. Ganad., Montevideo* **22** pp. 238–241, 1 ref. 1938. (Abstr. in *Vet. Bull.* **10** no. 3 p. 179. Weybridge, 1940.)

Identification of collections of ticks revealed the presence of *Ixodes ricinus*, L., in the departments of Rocha, Cerro Largo and Maldonado. The commonest host appeared to be the woodland deer, *Mazzama simplicornis*. The life-cycle of *I. ricinus* is summarised. It is concluded that the tick is established in eastern Uruguay and probably in other parts of the country.

DINULESCO (G.). **Recherches sur les gastrophiles en Roumanie (Etude systématique et biologique).**—*Arch. roum. Path. exp. Microbiol.* **11** no. 3 pp. 315–335, 6 col. pls., 4 refs. Paris, 1938. [Recd. 1940.]

Investigations on the Oestrids of the genus *Gastrophilus* that attack equines in Rumania were carried out in 1925, 1927, 1928 and 1937 and much of the information obtained has already been noticed [*cf.* *R.A.E.*, B **20** 135, etc.]. Descriptions are given of the adults of both sexes of the species that occur in Rumania, namely *G. intestinalis*, DeG.,

G. pecorum, F., *G. haemorrhoidalis*, L., *G. inermis*, Brauer, and *G. nasalis*, L., together with the characters distinguishing a new variety, *G. nasalis* var. *aureus*. The larvae of all the species infest horses and mules, those of the first three attach themselves in the stomach and those of the rest in the intestines or rectum. The seasonal prevalence of larvae of different instars is discussed. The adults, which live 1–2 days, begin to appear in July and disappear in October. Devices designed to protect animals from their attack should therefore be worn from the beginning of July to the end of October, and brushing the animals with warm water to destroy the young larvae [*cf.* **18** 117] should be carried out at 5-day intervals throughout this period. The pupal stage lasts 15–25 days.

ROE (R. J.). **Annual Report of the Veterinary Service for the Year 1938.**—*Rep. Dep. Agric. Cyprus 1938* repr. 7 pp. Nicosia, 1939.

The information obtained from preliminary investigations on the ox-warble flies, *Hypoderma bovis*, DeG., and *H. lineatum*, Vill., in Cyprus, which were continued up to April 1938 [*cf. R.A.E.*, B **27** 99] indicated the advisability of applying treatment to all cattle in an endeavour ultimately to eradicate the flies from the Island. In May, the Government approved a three-year scheme that entails the examination of all bovines once a month from December to April and the application of a derris preparation to every warble that can be seen or felt. Each dresser is equipped with a stiff brush for removing crusts over the warbles and a locally made device for holding and applying the derris emulsion. This device consists of a metal cylinder 9 inches long and 2½ in diameter, the upper end of which is closed by a cork with a small air vent. On the lower end there is a valve on a projecting rod fitted with a spring, and the liquid escapes when the rod is pressed on the animal's back. The cylinder holds a pint of liquid and has a hook for attaching it to the overall of the dresser when it is not in use. In one area in the extreme north-eastern part of the Island, there are small numbers of wild cattle, the progeny of domestic animals, which have never been handled. It will be necessary to catch and tame these animals, as is done by the inhabitants from time to time, or to dispose of them otherwise. The goat warble fly, *H. aeratum*, Aust. [*cf. loc. cit.*] has not been found on cattle.

MILLER (D.). **Blow-flies (Calliphoridae), and their Associates in New Zealand.**—*Cawthron Inst. Monogr.* no. 2, 68 pp., 8 pls. (1 col.), 124 refs. Nelson, 1939.

The main part of this paper is divided into three sections ; the first deals with the control of sheep-maggot flies and is compiled almost entirely from recent work in Australia [*cf. R.A.E.*, B **24** 38, 133, etc.], the second is a historical review of the literature on the New Zealand Muscoids [**21** 71], with a key for their separation into groups, and the third and longest comprises a list of the blowflies occurring in New Zealand, keys to the genera and species (including larvae in the case of *Calliphora*), descriptions of the adults and of the larvae where these are known, and very brief notes on the bionomics of some of them.

The species comprise *Chrysomyia rufifacies*, Macq., *Lucilia sericata*, Mg., two unidentified species of *Lucilia* (referred to as A and B),

Calliphora rufipes, Macq. (of which *C. milleri*, Hardy, as well as *C. hilli*, Patt., are considered to be synonyms [*cf.* **25** 282]), *C. laemica*, White, *C. erythrocephala*, Mg., *C. icela*, Wlk., *C. viridiventris*, Mall., *C. antipodea*, Hutton, *C. quadrimaculata*, Swed., *C. hortona*, Wlk., and two new species, *C. nothocalliphoralis* and *C. neohortona*, of each of which only a single adult is known.

Recent research has confirmed previous indications that the primary flies concerned with myiasis in sheep in New Zealand are *C. laemica* and *L. sericata* and has shown that *C. rufipes* occurs on sheep with the former, but is not abundant. Associated with them, but mainly as a secondary fly, is *C. quadrimaculata*. *C. hortona* and *Chrysomyia rufifacies* have been reared alone from infested wool (though primary flies may have been present at an earlier date), as well as in association with the primary flies mentioned above. Experiments are now being carried out to secure definite data on primary and secondary flies and on the seasonal sequence of flies in New Zealand.

JACKSON (C. H. N.). **The Analysis of an Animal Population.**—*J. Anim. Ecol.* **8** no. 2 pp. 238–246, 1 graph, 1 ref. London, 1939.

The principle on which is based the author's estimation of a population of *Glossina morsitans*, Westw., in a given area is that if flies are marked and released on a certain date, the proportion of marked individuals found in a random collection of flies on a subsequent date should be the same as the proportion of marked flies released to the total population on the date of release [*cf. R.A.E.*, B **22** 12]. This would hold good if the ratio of marked to unmarked individuals were not altered because some flies die or leave the area and others emerge or enter it. It is the purpose of this paper to describe modifications of the method that take into account rates of emergence, death and dispersal. In the first modification, flies marked on a certain date are recaptured at regular intervals and the rate of decrease in the proportion of marked flies recaptured is noted. Using this rate of decrease, it is possible to calculate, by methods described, what proportion of the population the marked flies represented on the day they were marked. In the alternative modification, which is the converse of the first and may be used as a control for it, the calculation is based on the numbers, in a single collection of flies, of individuals that had been differentially marked at regular intervals previously.

ZUMPT (F.). **Die Verbreitung der *Glossina palpalis*-Subspezies im Belgischen Kongogebiet.** [The Distribution of the Subspecies of *Glossina palpalis* in the Belgian Congo.]—*Rev. Zool. Bot. afr.* **33** fasc. 2 pp. 136–149, 1 pl., 3 figs., 9 refs. Brussels, 1940.

The receipt from the Congo Museum at Tervueren of almost 2,300 examples of *Glossina palpalis*, R.-D., from different parts of the Belgian Congo has led the author to confirm the validity of the three subspecies erected by him [*cf. R.A.E.*, B **23** 160; **24** 309] and to dispute the conclusions of Patton [**25** 64]. The Congo region is particularly appropriate for investigations on this species, since all three subspecies occur there, together with intermediate forms. The author considers the terminology used by Hennig (1936) in a paper on the genitalia of the cyclorrhaphous Diptera [*cf.* also **25** 176] to be more satisfactory than that used by himself or by Patton and

has therefore adopted it. He describes the chitinous parts of the genitalia of the genus *Glossina* to explain the use of these terms.

He discusses the relative merits of the distinguishing characters and the methods of examination of specimens used by himself and Patton. He points out that, although the form of *G. palpalis* from which the species was described is unknown, it was more probably the form that occurs in the region at the mouth of the Congo than that found inland, and he, therefore, gives the name *G. palpalis palpalis* to the former, which was called var. *wellmani*, Aust., by Patton [**25** 64] and considers that Patton's type form is *G. p. fuscipes*, Newst., and his var. *fuscipes* a mixture of *G. p. fuscipes* and *G. p. martinii*, Zumpt. The synonymy of the three subspecies is shown in a list.

The identifiable localities in the Belgian Congo from which are recorded the three subspecies and the intermediate forms found in the material studied are given in lists and shown on a map. The subspecies *palpalis* is found only in the region round the mouth of the Congo, as far east as Thysville. At Lundu and Lemba there are forms intermediate between *palpalis* and *fuscipes*. Subspecies *fuscipes* is the most widely distributed ; it is present in its typical form in the immense rain-forest region between the Kassai-Sankuru, Congo and Ubangi rivers and extends eastwards as far as the Rift Valley north of Lake Kivu. The region south of the Sankuru is also part of the *fuscipes* area, but here preponderate atypical forms that have genitalia more or less resembling those of subspecies *martinii*. In the western part of this area typical *fuscipes* is also found, but the preponderance of atypical forms increases progressively to the east ; these eventually give place to typical *martinii*. In the region of the headwaters of the Sankuru and Lomami rivers, forms intermediate between *fuscipes* and *martinii* occur. Subspecies *martinii* is found in the Rift Valley south of Lake Kivu and in an area extending westwards to the headwaters of the Sankuru River. In the western part of this area are found females with genitalia resembling *fuscipes*, although those of the males resemble *martinii*.

Wilson (D. B.) & Wilson (M. E.). **Control of *A. gambiae* on Coffee Estates.**—*E. Afr. med. J.* **16** no. 11 pp. 405–415, 1 map, 1 graph, 2 refs. Nairobi, 1940.

An account is given of an attempt to control malaria on a group of coffee estates in the Northern Province of Tanganyika Territory, where the funds available were limited. Measures were restricted to known or probable breeding places of *Anopheles gambiae*, Giles, and consisted chiefly of oiling with a mixture of 1 part solar to 10 parts fuel oil. Where possible, sawdust was soaked in the mixture and scattered by hand, but on such breeding places as pools and the edges of furrows the oil was applied by means of pressure sprayers. Oiling was begun as soon as adults of *A. gambiae* were found in houses, and the whole area in which breeding could take place was covered once a week. Borrow pits and pools that were too large to be cheaply filled were packed with cut vegetation, about 50 hollows being regularly treated by this method. Although no fully permanent works could be attempted with the funds available, a number of earth drains were dug. In the breeding season only oiling, packing and the maintenance of drains was possible. Some stone-pitched slopes were made for cattle

crossings and watering places to prevent the creation of breeding places in hoof-marks. The cost of the measures is discussed.

The oiling began in 1937, but was not fully effective until July, and from that month until March 1938 no female Anophelines were taken in houses. The average number of females per house per year was 3·75 in 1936, 3·22 in 1937, and 1·20 in 1938, and the average for the first 6 months of 1939 was 1·1 as compared with 2·0 for the same months of the previous year. Moreover the months of heavy Anopheline infestation in 1938 and 1939 were reduced to two as compared with seven in the previous years, and the period of malaria transmission, which before control was attempted lasted for eight months, was reduced to four or perhaps three. The reduction in transmission is further indicated by a lower rate of infection in Anophelines. As each area becomes better drained, and there are fewer incidental breeding places, it is anticipated that control by oiling will become progressively more effective. It is concluded that the results achieved justify the expenditure incurred and the methods adopted.

Corradetti (A.). **La biologia dell'*Anopheles gambiae* e il problema malarico nell'Africa Orientale Italiana.** [The Biology of *A. gambiae* and the Malaria Problem in Italian East Africa.]—*Riv. Biol. colon.* **2** pt. 5 pp. 321–327, 3 refs. Rome, 1939. (With Summaries in English, French and German.)

Most of the information given here on *Anopheles gambiae*, Giles, in Italian East Africa has already been noticed [*cf. R.A.E.*, B **26** 183, 215; **28** 62, 117]. *A. gambiae* is highly adaptable to changes in environment; the larvae have been found to resist submersion under water for over 12 hours and are not killed by the jolting incidental to transport. At present there exists no means for eliminating malaria in the districts infested by this Anopheline, and the only possible measures of control are screening, quinine prophylaxis, and medical treatment.

Ghidini (G. M.). **Nuovi dati sulla distribuzione delle Glossine nelle terre dell'Impero.** [New Data on the Distribution of *Glossina* in the Italian Empire.]—*Riv. Biol. colon.* **2** pt. 5 pp. 329-333, 2 figs., 3 refs. Rome, 1939. (With Summaries in English, French and German.)

An examination of tsetse flies collected in Italian East Africa near the Baro and Ghilo rivers in the Gambela region adjoining the Anglo-Egyptian Sudan showed the species present to be *Glossina palpalis fuscipes*, Newst., *G. tachinoides*, Westw., which had not previously been recorded from this region, and *G. pallidipes*, Aust. The distribution in Africa of these three flies is shown on a map.

Tarantino (G. B.). **La Heart-water e la lotta contro le zecche nel governatorato dei Galla e Sidama.** [Heartwater and Tick Control in the Galla and Sidama Province.]—*Riv. Biol. colon.* **2** pt. 5 pp. 335–344. Rome, 1939. (With Summaries in English, French and German.)

Heartwater, which is caused by *Rickettsia ruminantium*, occurs in sheep in the Galla and Sidama region of Abyssinia, but owing to the

high resistance of native sheep, it was not observed until sheep were imported to improve the stock from regions in which the disease does not occur. A list is given of the ticks of the genus *Amblyomma* that have been recorded from Italian East Africa. The commonest of these in the Galla and Sidama region is *A. hebraeum*, Koch, which is the chief vector of heartwater. The life-history of this tick is briefly summarised and its control is discussed [*cf. R.A.E.*, B **18** 101, 102]. Experiments have shown that the best protection is given by weekly applications to the shins and muzzle of sheep of a mixture of used lubricating oil with 0·2 per cent. arsenic, 2·5 per cent. wood tar and 3 per cent. turpentine.

HOLLAND (G. P.). **Notes on the Ecology of *Dermacentor andersoni* in southern Alberta.**—*Proc. ent. Soc. B.C.* no. 36 pp. 8–11. Victoria, B.C., 1940.

Since cases of Rocky Mountain spotted fever have occurred in Alberta during recent years, a study of *Dermacentor andersoni*, Stiles, the vector of this and other diseases, is of importance, and data on its habits and distribution, which are given in this paper, were collected in southern Alberta during April–July 1938. At the present time, *D. andersoni* is known to occur from the southern border of Alberta across the breadth of the Province and north at least to Red Deer (about 52°15′N. lat.). The general opinion seems to be that the infested areas are becoming increasingly abundant and that the tick is gradually spreading northwards. In the course of a survey along the southern border of the Province, only the short-grass prairie in the south-eastern corner was found to be heavily infested (though there were a few ticks in other localities), and it was in this area that most of the collecting was carried out. Ground squirrels (*Citellus richardsoni*) and hares (*Lepus townsendi campanius*) are fairly abundant there and are probably the more important hosts of the larval and nymphal ticks. The adult ticks are also picked up by the hares and probably by the native antelope (*Antilocapra americana*), which is still fairly common, but domestic sheep, cattle and horses are their more important hosts. Although the ticks were sometimes fairly numerous on the open rangelands, the largest numbers were obtained in the vicinity of water. The old river beds that traverse this part of the country were nearly all infested to a greater or less degree, the smaller deeper valleys of tributaries with steeply sloping sides being more favourable habitats than the wide bottomlands of the main river beds. Since ticks are sensitive to lack of humidity, it is not surprising that open, dry and wind-swept areas were less frequented. The ticks occurred on low bushes and various grasses. On dull, warm humid days, especially just prior to rain, they were very active and readily collected on the drags (pieces of white flannelette, one yard square), whereas on cold and windy days or those that were particularly hot and dry most of them were too lethargic to hang on to the drag or fell off it before they could be transferred to vials. In south-eastern Alberta, the tick season apparently begins late in March, depending on weather conditions, reaches its peak in May and early June and comes to an end in July. Owing to the unusually wet spring of 1938, only about 35 days were suitable for collecting, but during this time nearly 22,000 ticks were obtained.

Holland (G. P.). **New Records of Siphonaptera for British Columbia.**—*Proc. ent. Soc. B.C.* no. 36 pp. 11–12, 3 refs. Victoria, B.C., 1940.

The 5 species of fleas recorded for the first time from British Columbia include *Xenopsylla cheopis*, Roths., 9 examples of which were taken on *Mus* (*Rattus*) *norvegicus* caught at the city dump of Vancouver and 1 on *M.* (*R.*) *rattus alexandrinus* in a warehouse at New Westminster.

Spencer (G. J.). **Ectoparasites of Birds and Mammals of British Columbia IV. The Parasites of Bats.**—*Proc. ent. Soc. B.C.* no. 36 pp. 16–18. Victoria, B.C., 1940. **V. Parasites of Domestic Animals (Mammals).**—*Op. cit.* pp. 19–23.

In the first paper, notes are given on the Arthropod parasites recorded from 8 out of the 18 species of bats so far taken in British Columbia, and in the second on the lice, fleas and mites recorded from domestic and laboratory animals and man in the same Province.

The treatment recommended for the control of *Otodectes cynotis*, Hering, and *O. c. felis*, Huber, which may be found in the ears of dogs and cats, respectively, is to swab the ears with cotton wool to remove accumulations of wax and the dead bodies and cast skins of the mites, and then to pour into them a small amount of a mixture of 1 gm. beta-naphthol, 3 cc. ether and 10 cc. castor oil. Derris powder, either dry or as a saponified wash, has proved very effective against *Pediculus humanus*, L., *P. h. capitis*, DeG., and *Phthirus pubis*, L., infesting man.

Young (F. N.) & Goff (C. C.). **An annotated List of the Arthropods found in the Burrows of the Florida Gopher Tortoise,** *Gopherus polyphemus* **(Daudin).**—*Florida Ent.* **22** no. 4 pp. 53–62, 8 refs. Gainesville, Fla, 1939.

The burrows of *Gopherus polyphemus* are described, and a list is given of the numerous Arthropods that have been found in them in Florida. They include *Ornithodorus turicata*, Dugès, which is not apparently a parasite of the tortoise, but merely inhabits its burrows, and *Amblyomma tuberculatum*, Marx, which was in all cases taken on the tortoise.

Trager (W.). **A Note on the Problem of acquired Immunity to Argasid Ticks.**—*J. Parasit.* **26** no. 1 pp. 71–74, 4 refs. Lancaster, Pa., 1940.

In view of the finding that a certain degree of immunity from further attack was acquired by animals that had been infested by Ixodid ticks [*cf. R.A.E.*, B **27** 172, 199], experiments here described were carried out to determine whether a similar immunity was produced by infestation with Argasids. Chickens that had been repeatedly infested with nymphs and adults of *Argas persicus*, Oken, did not show any immunity from these stages of the tick, which engorge in 5–10 minutes. They did, however, exhibit a partial immunity from the larvae of *A. persicus*, which require at least 4 days for engorgement. Guineapigs exposed to repeated infestation with *Ornithodorus venezuelensis*, Brumpt, all stages of which engorge rapidly, showed no immunity from any stages of this tick.

Lindquist (A. W.). **The Introduction of an Indigenous Blowfly Parasite, *Alysia ridibunda* Say, into Uvalde County, Texas.**—*Ann. ent. Soc. Amer.* **33** no. 1 pp. 103–112, 3 refs. Columbus, Ohio, 1940.

The following is substantially the author's summary: *Alysia ridibunda*, Say, a blowfly parasite discovered in southern Arizona and New Mexico, but occurring generally over the eastern portions of the United States and in parts of Canada, was introduced into Uvalde County, Texas, in 1934 and 1935. Laboratory rearing showed the duration of the immature stages to be from 19 to 350 days. Over 50,000 adults of this parasite were reared in the laboratory and released in the autumn of 1934 and the spring of 1935. By 1st July 1935, the insect had built up a tremendous population and was found on practically every carcass and small piece of carrion. The percentage parasitism of blowfly larvae by it ranged up to 100, with an average of 37·1 from 1st April to 21st September, as indicated by exposure in jars of 4-ounce meat baits infested with blowfly larvae. The parasite diminished greatly in numbers in 1936, and only two individuals were seen in 1937 and three in 1938.

In 1935 the parasite emerged from 80·9 per cent. of *Sarcophaga* larvae and from 10·4 per cent. of *Lucilia* larvae collected in the field. This indicated that *Sarcophaga* was a preferred host. No emergence occurred from other blowfly larvae. In the laboratory, the females oviposited on larvae of *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.), including some in wounds on guineapigs, but both host and parasite larvae died. The examination of approximately 300 cases of myiasis in domestic animals failed to reveal the parasite working on larvae in wounds in nature.

Dispersion from the release area in 1935–36 proceeded farther westward than in other directions, and greater numbers occurred in that direction. The point of recovery farthest from the point of release was 27 miles to the west. The causes for the remarkable increase in the population shortly after release and the subsequent marked decrease are not fully understood.

Mazzotti (L.). **Infección natural por *Trypanosoma cruzi* en otras dos especies de triatomas.** [Natural Infection by *T. cruzi* in a further two Species of *Triatoma*.]—*Rev. Inst. Salub. Enferm. trop.* **1** no. 1 pp. 73–78, 2 figs., 9 refs. Mexico, D.F., 1939. (With a Summary in English.)

The Triatomids found by the author in 1936–38 to be naturally infected by *Trypanosoma cruzi* in Mexico are *Triatoma phyllosoma*, Burm., another species of *Triatoma* and *Rhodnius prolixus*, Stål, in Oaxaca, *T. pallidipennis*, Stål, in Michoacán and Guerrero, *T. dimidiata*, Latr., in Yucatán, Campeche, Veracruz and Jalisco, and *T. rubida*, Uhler, in Sinaloa.

Vargas (L.). **Notas sobre mosquitos nuevos para Mexico.** [Notes on Mosquitos new to Mexico.]—*Rev. Inst. Salub. Enferm. trop.* **1** no. 1 pp. 101–104, 2 refs. Mexico, D.F., 1939.

A list is given of 5 mosquitos new to Mexico, and another of the Mexican mosquitos that transmit disease or pathogenic organisms in various parts of the world, showing the diseases concerned and, in the

case of yellow fever, including species that harbour the virus experimentally. No case of yellow fever has occurred in Mexico since 1923, although the percentage of houses infested by *Aëdes aegypti*, L. (*fasciatus*, F.) is fairly high.

ROBERTS (F. H. S.). **The Brown Dog Tick** (*Rhipicephalus sanguineus*).—*Qd agric. J.* **52** pt. 5 pp. 529–530, 1 fig. Brisbane, 1939.

Brief popular notes are given on the morphology and bionomics of *Rhipicephalus sanguineus*, Latr., which breeds very rapidly in the climate of Queensland and causes loss of vitality in dogs on which it is abundant, but is not associated in Australia with the transmission of disease. Occasionally it is carried into dwellings by dogs and, although it seldom attacks man, it may become sufficiently numerous to be considered an important household pest. Arsenical and phenolic dips may kill ticks on the dog, but do not prevent larvae, nymphs and young adults in the animal's sleeping quarters from attaching themselves shortly afterwards. Treatment with derris has been found to be the only way of preventing immediate reinfestation. It may be applied as a powder shaken well into the coat and on to the skin or as a wash that is allowed to dry on the coat. The wash is made by soaking 2 oz. derris powder overnight in 1 gal. water and adding, just before use next morning, enough soap to make a good lather. Derris should be used with caution on young puppies, especially those of delicate breeds, and care should be taken to keep it away from the animals' eyes, since it may cause them to become inflamed. Treatment should be carried out every 6–7 days until the infestation is eradicated, care being taken to remove by hand any ticks in the ears, on the eyelids or between the toes. All old bedding should be burned or boiled, and the bedding subsequently used should be examined and cleaned every week. All litter round the animal's sleeping quarters should be burned. Kennels and outhouses should be sprayed with creosote oil or crude oil, care being taken to force the spray into cracks and crevices. Houses that are heavily infested should be fumigated.

WOMERSLEY (H.). **Further Notes on the Australian Trombidiidae with Description of new Species.**—*Trans. roy. Soc. S. Aust.* **63** pt. 2 pp. 149–166, 10 figs. Adelaide, 1939.

The new species described in this further work on the Trombidiids of Australia [*cf. R.A.E.*, B **22** 208; **26** 127] include *Trombicula samboni*, which is the mite causing dermatitis in man in South Australia that has previously been identified as *T. hirsti*, Sambon [**18** 223; **25** 225]. *T. hirsti*, which was described from Queensland [**16** 19; **17** 111] is considered a synonym of *T. minor*, Berl., which was described from Java.

MILLER (D.). **Sheep Maggot-fly Problem. New Zealand Survey, 1937–38.**—*N.Z. J. Sci. Tech.* (A) **21** no. 4A pp. 240A–244A, 1 fig., 2 refs. Wellington, N.Z., 1939.

The information contained in this paper is based on collections of maggots taken from infested sheep by stock inspectors in many parts of New Zealand and sent with relevant data to the Cawthron Institute between October 1937 and June 1938, where they were reared to the adult stage. Since the whole country has not been covered and no

samples were received from the central and south-western parts of the North Island or from the west coast of the South Island, arrangements have been made for the survey to continue for a further period. From an analysis of 155 cases it was found that in 67·33 per cent. strike occurred on the crutch, tail and rump and was due to dirty wool and in 20·19 per cent. on clean wool on the neck and body ; the strikes in other situations were of little importance. *Calliphora laemica*, White, and *Lucilia sericata*, Mg., constituted 49 and 46·27 per cent., respectively, of the 14,843 flies belonging to 12 species that were reared. Both are recognised as primary flies [*cf. R.A.E.*, B **28** 140]. The percentages of strikes in which these flies occurred singly, together, or in association with other flies are given, but since the complete history of each strike is not known the figures are of little significance. Certain indications were also obtained regarding the relation of these two flies to season, climate and geographical distribution. *C. laemica* reached its peak in the first half of the summer (December) and *L. sericata* during the autumn (March). These two species comprised 75 per cent. and 11 per cent., respectively, of the flies reared from strikes in the North Island, and 34·95 and 62·65 per cent. of those from strikes in the South Island. The percentage of strikes in which *C. laemica* predominated decreased from north to south, whereas those in which *L. sericata* predominated increased ; this is in agreement with field data collected over a number of years. There are also indications that the distribution of these two flies can be correlated with the regions of high, intermediate and low rainfall. An analysis of the strikes in which they alone occurred showed that the percentages of *C. laemica* were 38·09 in the zone of high rainfall in the North Island, 23·80 and 33·33 in the zone of intermediate rainfall in the North and South Islands, respectively, and 4·78 in the zone of low rainfall, which is in the South Island ; the corresponding figures for *L. sericata* were 4·78, 0, 17·85 and 78·57.

GRANDORI (R.) & GRANDORI (L.). **Effetti tossici prodotti da derivati della calciocianamide sulla mosca delle olive e sulle gambusie.** [The toxic Effects produced by Derivatives of Calcium Cyanamide on the Olive Fly and on *Gambusia* Fish.]—*Boll. Zool. agrar. Bachic.* **9** pp. 46–51. Turin, 1940.

An account is given of the methods by which cyanamide and dicyandiamide were prepared from calcium cyanamide and of experiments in which pure cyanamide proved toxic to adults of *Dacus oleae*, Gmel. [*R.A.E.*, A **28** 391]. Dicyandiamide in solutions of 0·5, 1, 3, and 5 per mille with 10 per cent. beet molasses proved quite ineffective in bait sprays against adult house-flies [*Musca domestica*, L.], and a 2 per mille solution of dicyandiamide in spring water had no effect on *Gambusia*, even when renewed every 10 days. The fish died in a few hours, however, when placed in solutions of pure cyanamide at a concentration of one per mille or more.

HUSEN (W. G.). **Insecticide Staining. A Study of Tests on Wall Papers with Insect Sprays, Base Oils and other Solvents.**—*Soap* **16** no. 3 pp. 101, 103, 105, 107, 4 figs. New York, N.Y., 1940.

Although most of the insect sprays on the market do not stain wall-papers and fabrics when used in the form of a fine mist and

according to manufacturers' directions, staining may result when they are applied in other ways, and an account is here given of a study of staining on wallpapers. It is concluded that under certain test conditions wall-papers of all types are stained when subjected to the action of insecticide bases and solvents. The moisture content of the papers is an important factor, since the more moist the paper, the more pronounced the stain. The stain intensity appears to be highest with the starch type of wall-paper, less with the protein type and least with the rotogravure ink type.

Roubaud (E.). **Emploi du fluorure de sodium dans la lutte contre les puces d'habitations.**—*Bull. Soc. Path. exot.* **33** no. 2 pp. 96–99, 3 refs. Paris, 1940.

The author carried out various tests in the laboratory to determine the effect of sodium fluoride either alone or mixed with an inert carrier on *Ctenocephalides* (*Ctenocephalus*) *felis*, Bch., *C.* (*C.*) *canis*, Curt., and *Xenopsylla cheopis*, Roths. He concludes that its action on adult fleas is too slow to make it of practical value as an insecticide for use on the bodies of animals, but that the results against the larvae were satisfactory. A mixture in inert dusts of 1 part to 9 was about as effective as the pure substance, and killed the larvae of *C. canis* in 18–24 hours. The price of this product is low (it is a by-product in the manufacture of aluminium from cryolite) and its toxicity for man and domestic animals is about 30 times less than that of arsenites; it is, therefore, suggested that it could be used with advantage in dwellings infested with fleas. Satisfactory results were obtained in flats infested with *C. canis* and *C. felis* by spreading the powder on the floor (either pure or mixed with an equal volume of inert dust) at the rate of 0·06 oz. per square yard and brushing it into the cracks. It is pointed out that larger proportions of inert dust could be used and that the method could be applied to infestations in shops or business premises, particularly in warm regions in places where débris from grain forms a medium particularly favourable for the development of *X. cheopis*.

Rodhain (J.) & van Hoof (T.). **Contribution à l'étude des *Plasmodium* des singes africains. Le comportement différent des *Pl. gonderi* et *Pl. kochi* chez les moustiques.**—*Bull. Soc. Path. exot.* **33** no. 2 pp. 107–113, 6 refs. Paris, 1940.

Since little is known of the biology of malaria parasites that infect baboons and monkeys in Africa, the authors describe experiments on the transmission by mosquitos of *Plasmodium kochi* and *P. gonderi*, the only two species that have been accurately identified. No development of *P. kochi* took place in *Anopheles maculipennis*, Mg., race *atroparvus*, van Thiel, in *Aëdes aegypti*, L. (*Stegomyia fasciata*, F.) or in *Culex pipiens*, L., though the numbers of the latter species that fed on the infected baboon were too small to enable any significant conclusion to be drawn. *P. gonderi* completed its development in race *atroparvus* and was transmitted by the bite of this mosquito. In a single experiment, 20 out of 28 females of race *atroparvus* became infected with *P. cynomolgi*, which was transmitted to a healthy monkey (*Macacus rhesus*) [*cf. R.A.E.*, B **25** 74; **27** 16]. *P. cynomolgi* is known to develop in some Indian Anophelines, and it is therefore suggested that the closely allied *P. gonderi* may have various Anopheline hosts.

Harvey (W. C.) & Hill (H.). **Insect Pests.**—Cr. 8vo, ix+292 pp., 23 figs. London, H. K. Lewis & Co., Ltd., 1940. Price 10*s*. 6*d*.

In view of the increasing attention that has been directed of recent years to the study of insects that occur in houses in Britain, particularly those that attack man, and the fact that the war has produced conditions in which the need for the control of such pests has become obvious, the authors have compiled this practical handbook in which the essential information needed by the authorities responsible for such work has been summarised. The first and shorter part of the book (pp. 3–96) deals principally with the insects concerned and includes an introductory chapter giving an outline of the principles of insect control and notes on their general characteristics, metamorphosis and growth, separate chapters on the bionomics, control, etc., of the bed-bug (*Cimex lectularius*, L.), fleas, and lice (*Pediculus humanus*, L., and *Phthirus pubis*, L.) and a single chapter on insect pests that occur in houses, but do not attack man. The chapters in the second part deal respectively with the relation of infestation to construction ; the principal gaseous fumigants ; other means of control, such as liquid contact insecticides, insect powders, super-heating, steam disinfection and the use of soap and water ; the technique of fumigation for premises, furniture, and removal vans ; the properties in which insects may have to be destroyed (new houses, old houses prior to demolition, etc.) and the importance of educating officials and laymen if the pests are to be satisfactorily eradicated ; the British legislation applicable to insect control in houses ; the toxic effects of certain fumigants on man and methods of treatment ; the control of insects infesting foodstuffs ; and the control of insects in ships. The appendices contain reproductions of forms and propaganda leaflets used by various local authorities in this work.

Gough (H. C.). **The Toxicity of Sulphur Dioxide to the Bed-bug** *Cimex lectularius* **L.**—*Ann. appl. Biol.* **27** no. 1 pp. 101–109, 3 diagr., 21 refs. London, 1940.

The investigations described were undertaken with a view to finding an explanation for the occasional failures reported when sulphur dioxide was used as a fumigant for the control of *Cimex lectularius*, L., in houses. They included tests of the relative resistance of the different stages of the bug to sulphur dioxide under constant conditions, the results of which have been noticed from a summary [*R.A.E.*, B **26** 77]. In these tests, the period of exposure was 2½ hours and the nymphs and adults were exposed 2 days after they had fed. Since the bugs can withstand starvation for long periods, tests were also undertaken to determine the effect of starvation on resistance, and the preliminary results indicated that starved nymphs and adults are more resistant than those recently fed and that the resistance of nymphs starved for long periods may be nearly as high as that of eggs.

Potter (C.) & Musgrave (A. J.). **Some Preliminary Experiments with β-butoxy-β′-thiocyanodiethylether as an Industrial Insecticide.**—*Ann. appl. Biol.* **27** no. 1 pp. 110–121, 11 refs. London, 1940.

The results are given of some preliminary experiments in the laboratory on the action of β-butoxy-β′-thiocyanodiethylether on

Cimex lectularius, L. [*cf. R.A.E.*, B **27** 251] and some of the more important pests of stored products. This substance, which is also known as normal butyl carbitol thiocyanate (or rhodanate), is sold under the proprietary name of Lethane. The concentrated thiocyanate is obtainable in a refined kerosene at two dilutions, Lethane 384 and Lethane 410, containing, respectively, 50 and 75 per cent. of the thiocyanate. Specifications are given for the highly refined odourless kerosene and the highly refined white oil used for making the working dilutions. *C. lectularius* was the only insect that was reared under standard conditions (at 23°C. [73·4°F.] and approximately 70 per cent. relative humidity) and even then considerable variations were observed in its susceptibility during the course of the work. The insecticide was applied as a spray atomised by means of a gun through a tubular structure on to a glass plate on which the insects were placed, as a fumigant, when it was placed in the lower compartment of a desiccator containing insects in muslin-covered glass tubes in the upper compartment, and as a film sprayed on to squares of wood on which the insects were subsequently exposed for different periods [*cf.* A **27** 154].

Almost all the other insects tested were susceptible in varying degrees to the thiocyanate in one form or another, and *C. lectularius* was susceptible to it in all these forms. The adults and nymphs were very susceptible to the kerosene oil diluent alone, as a spray. A film of 6 per cent. thiocyanate killed all nymphs and adults. The eggs were particularly susceptible, a spray of $\frac{1}{2}$ per cent. thiocyanate in odourless kerosene giving 96 per cent. mortality when the approximate weight of the spray deposit was only 1 mg. per sq. inch ; this susceptibility has been confirmed in later work. They were also found to be highly susceptible to a very light film containing 12 per cent. thiocyanate, and to the fumigation effect.

LLOYD (L.), GRAHAM (J. F.) & REYNOLDSON (T. B.). **Materials for a Study in Animal Competition, the Fauna of the Sewage Bacteria Beds.** –*Ann. appl. Biol.* **27** no. 1 pp. 122-150, 22 refs. London, 1940.

A detailed account is given of investigations that have been carried out for a number of years on the fauna of sewage beds, with particular reference to those at Knostrop, Leeds [*cf. R.A.E.*, B **26** 113], and to studies there on the effects of competition on the abundance of the insect fauna. Such studies are of practical interest, since the beds become choked and useless unless the scouring organisms (of which the five Diptera [*loc. cit.*] form an essential part at Knostrop) can keep pace with the growth of algae, bacteria, fungi, protozoa and other organisms and the accumulation of débris. Once a bed shows signs of choking, it should be rested to enable the scouring organisms to regain control. If sewage is fed to choking beds, it becomes foul and unsuitable to the scourers, and in the final stages becomes impervious. No scouring organisms can then re-open it, and the cost of digging out the great mass of medium is prohibitive. At Knostrop, with its mixed fauna, competition prevents any of the flies breeding to excess. The beds are always open and never really require rest except during the night when the flow is reduced and rest is convenient. There is no doubt that the mixed fauna is best for the beds, but the reasons for the limitation of the fauna in certain sewage works are by no means clear, and prolonged investigations will be necessary to determine whether it

is due to the character of the sewage, the routine of feeding it to the beds, the type of distributor, the medium used, or the way in which the bed is constructed. Although the flies inhabiting the beds are not normally predacious, tests in the laboratory indicated that when no other food is available, they attack one another to a greater or lesser extent.

The following is taken from the authors' summary: The fauna of the beds at Knostrop is a balanced one and comprises in particular the Enchytraeid worm, *Lumbricillus lineatus*, *Psychoda* spp., and the Chironomids, *Metriocnemus* spp., and *Spaniotoma minima*, Mg. [*cf. loc. cit.*]. The seasonal abundance of the species of *Psychoda* is shown to be lower, particularly in late summer, than would be accounted for by climatic influences. These flies are more numerous at neighbouring sewage works where the Chironomid fauna is absent or more limited. The sweeping action of the Knostrop sewage distributors determines to some extent the relative abundance of *Psychoda* and Chironomids in various parts of the beds and a tendency of the latter to keep down the *Psychoda* is demonstrated. Larvae of species of *Metriocnemus* and the Enchytraeid worm occupy the topmost foot of the medium, whereas larvae of *Psychoda alternata*, Say, are most abundant below this zone. On the other hand, the topmost foot is also the preferred zone of *Psychoda* larvae, and they occupy it at neighbouring works where *Metriocnemus* is absent. On these several grounds a competition amongst the scouring organisms is evident, and this should be capable of analysis.

The Chironomid larvae in particular develop a predatory tendency in the absence of more normal food, and this is believed to be a strong element in the competition. Eggs, pupae and worm cocoons are loosened from the medium by the activities of the grazing organisms, and it is shown that the numbers washed away from the beds in the effluent may be in part due to such interference. Most of the loss of larvae by this means, however, is associated with the spring off-loading of the beds and is due to the worms and larvae following the food they have loosened to the bottom of the beds and passing through the floor in search of nutriment. At this time scouring reduces the available food to small proportions, and the fly breeding is checked in consequence. Overpopulation of the beds may also occur locally at other seasons of the year, and evidence is given of a consequent increased mortality in *Metriocnemus longitarsus*, Goet., and a reduction in weight of the emerging flies of this species and of *Spaniotoma minima*.

WEYER (F.). **Die Gesetzmässigkeiten in der geographischen Verbreitung der Rassen von** *Anopheles maculipennis*. [The Laws governing the geographical Distribution of the Races of *A. maculipennis*.]—*Norsk ent. Tidsskr.* **5** pt. 4 pp. 168–177, 2 maps, 8 refs. Oslo, **1940**.

The author briefly summarises the results of his work on the distribution in Germany of *Anopheles maculipennis*, Mg., races *maculipennis* (*typicus*), *atroparvus*, van Thiel, and *messeae*, Flni. [*cf. R.A.E.*, B **27** 78, etc.], and discusses the reasons for the European distribution of the last two. While *messeae* is a true fresh-water form, *atroparvus*, which usually breeds in brackish water, has been found in fresh water in Germany [**23** 32] and Holland [**27** 115], so that its occurrence

cannot be entirely dependent on the chlorine content of the water, and some unknown factor must be involved. In experiments, van Thiel found no differences in oviposition and larval development in *atroparvus* and *messeae* in fresh or brackish water [*cf.* **27** 51]. The fact that the distribution of *atroparvus* does not extend beyond East Prussia and southern Sweden indicates that it is limited by climate. Of climatic factors, Ekblom considers that atmospheric humidity is more important than temperature, and this view is supported by Hundertmark's experiments in which newly emerged females of race *atroparvus* always sought the highest humidity [**26** 215]. It might explain the occurrence of this race on the coast, but not its presence in central Germany, Hungary and Rumania. Further work is desirable on the influence of climatic factors on the various stages of development of the mosquitos.

LAWLOR (W. K.). **Notes on a Variation in the Eggs of** *Anopheles punctipennis* **Say.**—*Publ. Hlth Rep.* **55** no. 9 pp. 371–373, 2 pls., 6 refs. Washington, D.C., 1940.

The following is based on the author's summary and conclusions: Females of *Anopheles punctipennis*, Say, caught in Georgia in January and February 1938 laid eggs of an unusual type. These females were morphologically indistinguishable from those that had laid eggs of the usual type during other months of the year. Further studies are necessary before it can be definitely stated that the unusual type of egg here described is a seasonal variation.

EDWARDS (F. W.) & BOX (H. E.). **Notes on Mosquitoes.**—*Ann. Mag. nat. Hist.* (11) **5** no. 27 pp. 314–322. London, 1940.

A collection of mosquitos was made in Antigua by H. E. Box during September and October 1938 (rainy season). He found 15 species, including all of the 7 previously collected there. In the first part of the paper, Edwards gives a list of the 15 species, showing their distribution outside the Island, and systematic notes on some of the species of *Culex*. In the second part, Box gives brief notes on the localities and types of habitat in which the various species were found.

DEL PONTE (E.). **Observaciones sobre** *Anopheles pseudopunctipennis* **en La Mendieta, provincia de Jujuy.** [Observations on *A. pseudopunctipennis* at La Mendieta in the Province of Jujuy.]—*Rev. Inst. bact.* **9** no. 2 pp. 149–155, 1 fig. Buenos Aires, 1939.

Investigations were carried out in February-March 1939 on the importance of *Anopheles pseudopunctipennis*, Theo., as a vector of malaria [*cf. R.A.E.*, B **27** 12] at La Mendieta, a settlement in one of the most malarious districts in the province of Jujuy, Argentina, at an altitude of about 2,400 ft. Of 132 persons whose blood was examined, ten were infected with *Plasmodium vivax*, six with *P. falciparum*, and four with *P. malariae*, while one had a mixed infection. Of 45,818 Anophelines taken in 1938 in houses in the provinces of Tucuman, Catamarca, Salta and Jujuy, 45,569 were *A. pseudopunctipennis*, and in the author's

investigations in La Mendieta this species was the only Anopheline taken in houses. It was the commonest species caught at nightfall near the settlement by means of human bait, the others being *A. albitarsis*, Arrib., *A. argyritarsis*, R.-D., and *A. tarsimaculatus*, Goeldi, and was the only one taken at night in the hills. It was also taken in a trap baited with a calf. It attacked man throughout the night in the hills, and the probability of contracting malaria depends chiefly on the percentage of infection in it. No infection was observed in 56 females of *A. pseudopunctipennis* taken in the hills with human bait, but of 644 taken near the settlement 1·7 per cent. showed oöcysts on the stomach. When batches of not less than 10 females of *A. pseudopunctipennis* were allowed to feed on carriers of gametocytes of *P. vivax*, and dissected 10 days later, no infection was observed. The morphology of the adults of both sexes, the larvae and the eggs of *A. pseudopunctipennis* is discussed, and a key is given to the pupae of the four Anophelines taken. Other mosquitos caught in the hills at La Mendieta included *Aëdes scapularis*, Rond., *Haemagogus* sp., and *Psorophora ferox*, Humboldt, which are potential vectors of jungle yellow fever. Larvae and adults of *C. fatigans*, Wied. (*quinquefasciatus*, auct.) and *Aëdes aegypti*, L., were taken in houses.

KRISHNAN (K. V.). **Report(s) of the Professor of Malariology and Rural Hygiene.**—*Rep. All-India Inst. Hyg. publ. Hlth* 1937 pp. 23–28; *Ibid.* 1938, pp. 27–32. Calcutta, 1938–39.

Investigations completed in 1937 showed that *Anopheles culicifacies*, Giles, does not establish itself permanently, or play a part in malaria transmission, in villages in Bengal, although the larvae are introduced every year in canal water. They appear during the non-malarious season in late winter and early spring, when the temperature of the water in the breeding places ranges between 80·6 and 84·2°F. and the ratio of dissolved carbon dioxide to oxygen is low (CO_2 being less than 0·2 and O_2 0·6 per 100,000 parts). These conditions are favourable for them. On the other hand, although the temperature (with maxima of 80–90 and minima of 70–80°F.) is favourable to the adults, the relative humidity is low (24–48 per cent.) and probably leads to the premature death of many of them. This suggestion is supported by the large numbers of larvae and small numbers of adults caught at this time. Later in the year, and particularly during the malaria season (July–October), when humidity as well as temperature is favourable for the adults, breeding conditions become unfavourable as a result of the rains. Not only does the temperature of the water rise to 90–95°F., but the ratio of CO_2 to O_2 is reversed (the former is increased to 1·0 per 100,000 parts and the latter reduced to less than 0·6). These conditions are, however, favourable for the breeding of *A. philippinensis*, Ludl., which is consequently responsible for malaria transmission.

The abnormally high incidence of malaria at the field centre during 1937 is believed to have been due to the unusual amount of rain that fell during the usually dry month of February and led to the early breeding of *A. philippinensis*. Adults of this species began to appear in March instead of July. Breeding increased greatly with the onset of the monsoon rains, and adults were exceptionally prevalent between July and October. The sporozoite rate was remarkably high and, as a consequence, the malaria incidence also. The parasite index,

the percentage of gametocyte carriers and the number of gametocytes per cubic millimetre all increased considerably and continued to do so over a longer period than usual. Reference to the history of malaria in the area revealed that such periodic increases occur once in 4–5 years, and a study of the rainfall records indicated that the increases were associated, as in 1937, with unusual rainfall during the drier months.

During 1938, a further study of the causes of the periodic outbreaks of malaria that occur in the field malaria centre, which is situated in the Burdwan District, confirmed previous findings. In 1936, which was a non-epidemic year, the parasite rate was 5–10 per cent. during the dry season (March–June), 25–30 per cent. in the malaria season (July–October), and 10–15 per cent. during the cold weather (November–February). In 1937, the first of two years with unusual rainfall in the dry months, no increase in malaria was noticed in the dry season, despite the fact that there was a marked increase in the Anopheline population and the conditions of temperature and humidity were favourable for transmission. This was probably attributable to the low numbers of gametocyte carriers. In the malaria season, however, both the number of Anophelines and the number of primary malaria cases increased. The parasite rate rose to 40–45 per cent. and this high rate persisted into the cold weather. The rainfall was again unusual during the dry months of 1938, and a severe epidemic occurred. Malaria was prevalent throughout the year and the parasite rate rose to 70 per cent. in the malaria season. It thus appears possible to predict an epidemic on the basis of the amount of rain falling in the dry months. It was also observed that more than 50 per cent. of the cases of malaria in February–May and July–September 1936 were due to *Plasmodium malariae*, whereas more than 50 per cent. in all months in the epidemic years were due to *P. falciparum*. The percentage due to *P. vivax* varied little during the three years. Thus, it appears possible, at least in this area, to forecast an epidemic rise in the ensuing malaria season from a study of the relative incidence of *P. malariae* and *P. falciparum* in the earlier months of the year (dry season).

Larvae of *A. philippinensis* were found in only a minority of the reservoirs in the malaria centre, and a chemical analysis of the water in them indicated that a high ratio of CO_2 to O_2 was favourable to breeding and a low ratio unfavourable, the reverse of the findings recorded for *A. culicifacies* in the previous year. It was also observed that larvae of *A. philippinensis* did not occur in reservoirs in which *Euglena* or *Macrocystis* was present or in rice-fields.

RUSSELL (P. F.) & MOHAN (B. N.). **Experimental Malaria Infections in two Races of** *A. stephensi*.—*Indian med. Gaz.* **74** no. 8 pp. 469, 470, 1 ref. Calcutta, 1939.

In comparative tests, *Anopheles stephensi*, List., and *A. s. mysorensis*, Sweet & Rao, were both easily infected with *Plasmodium falciparum* and were about equally susceptible [*cf. R.A.E.*, B **26** 50]. Out of 61 females of the type form and 89 of *mysorensis* dissected, 41 and 36 per cent., respectively, were found to be infected with sporozoites. No morphological differences were observed in the sporozoites in the two

forms. The females of the type form were reared from larvae in a laboratory colony that had originated in Madras, and those of *A. s. mysorensis* from larvae collected in Mysore.

SIDDONS (L. B.) & ROY (D. N.). **The early Stages of *Musca inferior* Stein.**—*Indian J. med. Res.* **27** no. 3 pp. 819–822, 1 pl., 5 refs. Calcutta, 1940.

Descriptions are given of the ovarian egg, third-instar larva and puparium of *Musca inferior*, Stein, based on material collected in Calcutta. This blood-sucking fly feeds on cattle and breeds in isolated pads of cow-dung. The pupa is parasitised by the Chalcid, *Dirhinus pachycerus*, Masi.

SMITH (R. O. A.), HALDER (K. C.) & AHMED (I.). **Further Light on the Mechanism of Sandfly Transmission of Kala-azar.**—*Indian med. Gaz.* **75** no. 2 pp. 67–69, 6 refs. Calcutta, 1940.

Until the last series of experiments in India on the transmission of visceral leishmaniasis by the bites of *Phlebotomus argentipes*, Ann. & Brun., was concluded in 1934, the sandflies used were kept alive on successive blood-meals according to the method recommended by Shortt, Barraud & Craighead [*R.A.E.*, B **14** 143]. The first feed, and usually the second also, was on a kala-azar patient in order to infect them and the third and subsequent feeds were on experimental animals. It was assumed that flagellates of *Leishmania donovani* would not be present in sufficient numbers at the " anterior station " to be inoculated by biting until the sandflies were ready for a third feed, which was about 6–7 days after the first [*cf.* **14** 144]. When research on the problem was renewed in 1939, it was found that the sandflies can be kept alive by feeding them on raisins from the third day after a blood-meal on an infected person until the tenth day when they are offered a blood meal on an experimental animal. At this age the flies are equivalent to those that are ready to take their fourth or fifth feeds under the old method, and flagellate infections may be assumed to be well advanced. Flagellate infections have been found to develop uninterruptedly in the sandflies, and although no records of the intensity of infection were kept previously, the person dissecting the sandflies had examined examples fed by both methods and is of the opinion that with the new method the infections are decidedly heavier. Whether sandflies take any food other than blood under natural conditions is not known, but the fact that *P. argentipes* is most prevalent under rural conditions where opportunities for imbibing fruit and plant juices are greater, practically throughout the year, favours such a possibility.

The examination of sandflies reported to have made persistent but unsuccessful efforts to obtain a blood-meal showed that almost all of them were heavily infected. In certain instances, the proventricular fold was almost completely obliterated [*cf.* **14** 144] and the oesophagus greatly distended with flagellates. It is suggested that these " blocked " sandflies are more likely to transmit infection than others, since their vigorous attempts to satisfy their hunger are likely to cause the detachment of flagellates from the " block " and these would find their way into the wound.

Raghavender Rao (S.). **Studies in the Epidemiology of Plague in H. E. H. the Nizam's Dominions : Comparison of certain Factors in a Plague-infected Place with that of neighbouring Plague-free Area.**—*Indian med. Gaz.* **75** no. 2 pp. 80–86, 1 fig., 1 map., 8 refs. Calcutta, 1940.

A detailed account is given of a rat-flea survey carried out in the town of Nalgonda, which is free from both human and rat plague, and the results are compared with those obtained in 1929–31 in the city of Hyderabad [*R.A.E.*, B **20** 28], which is only 64 miles distant and in free communication with Nalgonda, but in which plague has been present for a number of years. *Mus* (*Rattus*) *rattus* was the predominant rodent in both places. Comparative tests showed that rats from Nalgonda were as susceptible as rats from Madras, and those from Hyderabad, although they were a little more resistant, were not so resistant as those from Bombay. *Xenopsylla astia*, Roths., was the only flea found on rats in Nalgonda, whereas more than 94 per cent. of the fleas on rats at Hyderabad were *X. cheopis*, Roths. The climate at Nalgonda is hot and dry, and it is suggested that *X. astia*, which is not a very efficient vector of plague under normal circumstances, is rendered incapable of transmitting the disease by these adverse climatic conditions [*cf.* **12** 10 ; **13** 194].

Robertson (R. C.). **Malaria in western Yunnan with Reference to the China-Burma Highway.**—*Chin. med. J.* **57** no. 1 pp. 57–73, 1 map. Peiping, 1940.

The author briefly describes the new motor highway from Kunming (Yunnanfu), the capital of Yunnan Province, China, to Lashio, the capital of the Northern Shan State in Burma, which was opened to traffic early in 1939. Much of the region through which it passes is highly malarious, practically no measures were taken to combat the disease among the labourers engaged on its construction, and little is being done to protect the transport workers, among whom it is rife. From the point of view of malaria, the highway may be divided into several parts, the region from Kunming to the gorge of the Mekong in which malaria incidence is slight, a sparsely inhabited region where it is sporadic, being intense in the Paoshan valley and absent in the mountain ranges and gorges of the Mekong and Salween rivers, and a region from Lungling through Mangshih to the frontier, where it is severe. It is moderately prevalent in the British Shan State from the frontier post at Wanting to Lashio.

In order to obtain as many essential facts as possible regarding the malaria situation on the highway, a survey laboratory was set up at Mangshih. Examination of 600 transport workers, drivers and coolies at this place showed that 80 per cent. were infected with malignant tertian (*Plasmodium falciparum*). The parasite rate among school children was also high, though most of them did not show obvious symptoms of malaria. A report is made on a survey of the Lungling and Lushih districts, the latter including the towns of Mangshih and Chafeng and the most malarious part of the highway. The Anophelines taken included all those taken in a previous survey in Yunnan [*R.A.E.*, B **25** 99], except *Anopheles philippinensis*, Ludl., and in addition, *A. lindesayi*, Giles, *A. gigas*, Giles, *A. tessellatus*, Theo., *A. culicifacies*, Giles, *A. karwari*, James, and *A. annularis*, Wulp. The types of

breeding places in which larvae of the different species were found are enumerated. The numbers of females collected at random in houses in a representative area and dissected and, in brackets, the numbers infected with malaria parasites, were as follows : 380 (6) of *A. annularis*, 316 (31) of *A. minimus*, Theo., 232 (8) of *A. hyrcanus* var. *sinensis*, Wied., 101 (6) of *A. jeyporiensis*, James, 52 (2) of *A. culicifacies*, and 42 (3) of *A. maculatus*, Theo. Smaller numbers of three other Anophelines were also dissected, but they were not infected. Suggestions as to the lines along which malaria control should proceed in the future comprise chiefly the administration of drugs and protection from the bites of Anophelines, since measures against the larvae are not regarded as practicable.

JETTMAR (H. M.). **Some Experiments on the Resistance of the Larvae of Latrine Fly,** *Chrysomyia megacephala*, **against Chemicals.**—*Chin. med. J.* **57** no. 1 pp. 74–85, 6 refs. Peiping, 1940.

A severe outbreak of dysentery and other intestinal diseases caused a high mortality in Hanchung, southern Shensi, in the summer of 1938. It seemed probable that the flies that were breeding in enormous numbers in the latrines and were present in the streets, particularly on the numerous faecal piles, and on fruit, vegetables and other provisions in the market and in houses, were responsible, and experiments were, therefore, undertaken to find a cheap method of destroying the maggots by means of chemicals. Practically all the maggots in the latrines proved to be those of *Chrysomyia megacephala*, F. The substances tested were pyrethrum powder, lysol, acetic acid and potassium hydroxide, and each was used at 11 different concentrations, but none proved to be effective at a strength that would make its application economically possible under practical conditions. The most suitable method would appear to be to pour suddenly a large amount of boiling water on the surface of the faecal mass. The maggots are very susceptible to moist heat and are killed in a comparatively short time when exposed to temperatures only slightly above 40°C. [104°F.]. They must congregate at the surface of the mass, in order that their spiracles may project above it, and as the hot water is specifically lighter than the faecal mass, it lies on the surface and, during the hottest season of the year when the larvae are most abundant, it remains for a considerable time at a temperature above 40°C. The method is most effective in latrines in which the surface of the contents is not too extensive ; it is less easy to apply to latrines of the large trench type. Kerosene also destroyed the maggots by suffocation, but was too expensive to use on a large scale.

BAISAS (F. E.). **Malaria in Southern Abra.**—*Mon. Bull. Bur. Hlth Philipp. I.* **19** no. 10 pp. 393–406, 7 figs., 5 refs. Manila, 1939.

The possible causes of an outbreak of malaria that began in southern Abra, Philippine Islands, in November–December 1938 and lasted until January–February 1939 are discussed. It is the first serious outbreak that is known to have occurred there. A mosquito survey was made, and the species of larvae collected, and their numbers and breeding places, are shown in a table. It is thought that the epidemic may have been due to an increase in the abundance of *Anopheles minimus* var. *flavirostris*, Ludl., or in the virulence of the indigenous strains of malaria parasites or to the two acting together through the

suggested vitalising effect of frequent passage through the mosquitos on the malaria parasites. The factors that might have caused an increase in the population of the vector are discussed. The extreme difficulty of instituting malaria control is described, and it is concluded that the only possible measure is the establishment of dispensaries.

STRANGWAYS-DIXON (D.). *Gambusia affinis holbrookii*: **Imported Anti-malarial Fish in East Africa.**—*E. Afr. med. J.* **16** no. 12 pp. 450–455. Nairobi, 1940.

After discussing the use of fish of the genus *Gambusia* against Anopheline larvae and briefly describing their life-history and habits, the author gives an account of their first successful introduction into East Africa, in 1937, together with recommendations for their rearing and distribution. In June 1939, distribution centres were established in most provinces in Kenya, and were in the course of establishment in Uganda.

HOARE (C. A.). **Studies on the Behaviour of *Trypanosoma evansi* in Tsetse-flies with special Reference to its Phylogeny.**—*Parasitology* **32** no. 1 pp. 105–121, 1 map, 2 pp. refs. London, 1940.

The following is mainly the author's summary: In view of the morphological similarity of *Trypanosoma evansi* to *T. brucei*, including the sporadic occurrence in it of marked polymorphism, the hypothesis is advanced that it may have originated from *T. brucei* by the introduction of the latter into localities free from *Glossina* and its subsequent propagation by direct passages. It is shown that, in the Anglo-Egyptian Sudan, the area in which camels are infected with *T. evansi* and those in which *Glossina* spp. and the trypanosomes they transmit occur, overlap slightly, and this indicates the source from which *T. evansi* in that country may have originated and provides circumstantial evidence in support of the hypothesis.

Attempts were made to discover whether *T. evansi* can develop in *Glossina*. A total of 568 individuals of *G. morsitans*, Westw., were fed on infected mice and examined at periods of from 6 hours to a fortnight after the infective feed. The results were entirely negative; not only is the trypanosome incapable of establishing an infection in the fly, but most of the flagellates perish and are digested during the first hours after ingestion. The behaviour of *T. evansi* in *Glossina* is shown to be similar to that of non-transmissible strains of trypanosomes of the *brucei* group after prolonged maintenance by direct passages in the mammalian hosts, and is therefore also in keeping with the hypothesis.

MOSSOP (M. C.). **The Bed Bug and a new Aid for its Control. With Special Reference to Native Quarters.**—*Rhod. agric. J.* **37** nos. 2–3, pp. 109–125, 162–172, 1 pl., 2 figs., 7 refs.; also as *Bull. Minist. Agric. [S. Rhodesia]* no. 1145, 28 pp., 1 pl., 2 figs., 7 refs. Salisbury, S. Rhod., 1940.

Bed-bugs infest the rooms of most natives in towns and on mines in Southern Rhodesia, but are reported by many natives to be less troublesome in their huts in villages and kraals. In some kraals, the foliage and stems of certain bushes are placed under sleeping mats, and are said to be effective for a day or two in trapping bugs before they

reach the sleeper. Laboratory tests showed that both old and young bugs were trapped when placed on the upper surface of the leaves of one of these bushes (*Pseudarthria hookeri*), some being held there for weeks before they died. The leaves of the other bush (*Laggera alata*) were, however, only able to retain the younger bugs. *Cimex lectularius*, L., is by far the commoner of the two species found in Southern Rhodesia, *C. hemiptera*, F., being represented by only a comparatively few specimens in the insect collection of the Department of Agriculture. Brief notes are given on the general habits of the bugs. Observations on about a dozen examples of *C. lectularius* reared under rather artificial conditions in Salisbury showed that the life-cycle lasts about 10 weeks and confirm the view that at least one meal is necessary in each of the 5 instars.

Methods of control, which are discussed, include drastic measures, such as fumigation with hydrocyanic acid gas or sulphur dioxide and heating to a lethal degree, and measures that need to be continuously or repeatedly applied, such as the use of contact sprays, flaming with blow-lamps, etc. Control is most easily accomplished where crevices, whether in room construction, fittings or furniture, are fewest. With regard to heat, maintaining the temperature at 125°F. for several hours usually gives satisfactory results, but where penetration is slow, an exposure of 24 hours may be necessary. Household sprays containing pyrethrum, derris, etc., are usually applied to combat minor infestations or as a routine precaution against infestation, but they may in time considerably reduce even major infestations. Enough spray should be used to treat all possible hiding places. For a year, the author has used with apparent success the arbitrary amount of 2 fl. oz. a week in a plastered room (10 by 10 by 10 ft.) with cement floor and roof, occupied by 3 natives and their belongings. These volatile oil sprays, which have the additional advantage of controlling a number of other pests, should be applied at least once a week for as long as the presence of bugs is suspected ; the important time of year is from September to April or May. Satisfactory results were also obtained by the author with a less volatile pyrethrum spray similar to that used by Potter [*R.A.E.*, A **24** 191]. This contained 0·813 per cent. total pyrethrins and was atomised by a foot-operated paint sprayer at a pressure of 25–30 lb. per square inch. One fl. oz. per 1,000 cu. ft. was used at each application in a native's sleeping quarters ; the applications were made once a fortnight from October 1938, when the infestation was heavy, to the end of April 1939, but since no bugs were then found they were made once a month until the time of writing (January 1940). During this time no further infestation occurred, although complaints were received of infestations in neighbouring untreated rooms in September and October at a time when the population of bugs normally increases. The type of furnishing and the contents of this room were such as would normally render control of bugs unsatisfactory unless fumigation were used. This method is at present applicable to native rooms, dormitories, public waiting rooms, etc., and may later be useful in houses when more is known of the effect, after constant use, of the spray on furnishings and fabrics.

Since bed-bugs tend to crawl upwards after a meal or when seeking shelter and cannot crawl up, or on the underside of, a moderately polished smooth metal surface, experiments were carried out on the use of barriers that would confine the bugs to the lower part of the room, where they can be more easily destroyed. Artificial hiding

places in which the bugs could be periodically destroyed by flaming with a blow-lamp were also tested. The barrier, which was erected in two new native dormitories, consisted of a horizontal shelf of galvanised sheet iron let into the walls round the room at a height of 8 feet and projecting for 3 inches. The joints in it were soldered smoothly, and the adjoining plaster was carefully finished off so as to leave no crevices. The walls were plastered and whitewashed, and the underside of the barrier was smoothed by rubbing with sand and sacking. There was no ceiling, and the roof consisted of corrugated iron supported by unplaned wooden roof members that would normally provide excellent shelter for bugs. The rooms, which were first occupied in December 1935, were examined in April 1936 and about 50 bugs were found, mostly in groups immediately under the barrier or a few inches below it; none was found above it. A shelter of asbestos string to attract the bugs was then fixed beneath the barrier, but 3 inches below it, to prevent the heat from the blow-lamp spoiling the close joint between the barrier and the plaster. The blow-lamp was used on two successive days in each month from May until the end of 1936, and two double treatments were given in January 1937, but heavy infestation persisted. Examination showed that large numbers of bugs were hiding in the bunks, especially in the crevices where the angle-iron frames were let into the wall. In March 1937, all crevices were filled in and at the same time the asbestos shelter was replaced by strips ¾ inch wide of fine mine battery screening with about 500 meshes to the square inch. Although the former had proved a good shelter, its insulating qualities had made the destruction of the bugs a slow process and many escaped. The metal screening could be treated with greater speed and fewer bugs would then escape. From April 1937, bunks as well as shelters were treated with a blow-lamp once a week and the results were satisfactory. Only two bugs were found in each room in December 1937, when there would normally have been a heavy infestation. The clean condition in 1939 of the whitewash applied in December 1937 indicated that the treatment had continued to be effective. Instructions for using the blow-lamp to treat the shelter are given.

Papers noticed by Title only.

Smith (C. N.). **The Male, Nymph, and Larva of** *Ixodes dentatus* **Marx (Acarina: Ixodidae).**—*Proc. ent. Soc. Wash.* **42** no. 1 pp. 16–20, 9 figs., 4 refs. Washington, D.C., 1940.

Vargas (L.). **Notas sobre la quetotaxia de la larva del** *Anopheles pseudopunctipennis* **de Temixco, Morelos.** [Notes on the Chaetotaxy of the Larva of *A. pseudopunctipennis*, Theo., at Temixco in the State of Morelos, Mexico.]—*Rev. Inst. Salub. Enferm. trop.* **1** no. 1 pp. 79–99, 8 figs., 2 tables, 10 refs. Mexico, D.F., 1939. (With a Summary in English.)

Stains (G. S.) & Knowlton (G. F.). **Three new Western Simuliidae** [*Simulium twinni*, *S. hardyi* and *S. flaviantennus*, spp. n., from Utah] **(Diptera).**—*Ann. ent. Soc. Amer.* **33** no. 1 pp. 77–80, 1 fig. Columbus, Ohio, 1940.

De Meillon (B.). **New Simuliidae** [*Simulium mcmahoni* and *S. kenyae*, spp. n.] **from Kenya.**—*E. Afr. med. J.* **16** no. 12 pp. 446–449, 4 figs. Nairobi, 1940.

Covell (G.) & Afridi (M. K.). **Antimalaria Operations in Delhi. Part II.**—*J. Malar. Inst. India* **2** no. 4 pp. 315–340, 2 pls., 3 maps, 8 refs. Calcutta, 1939.

In this second paper on malaria control in Delhi [*cf. R.A.E.*, B **27** 207], an account is given of the measures, usually known as temporary, but which the authors prefer to call recurring, that are now being carried out against Anopheline larvae in the Delhi urban area. They include the application of larvicides, the removal of vegetation from breeding places, and minor levelling and draining operations. The organisation built up to apply and supervise these measures is described in detail, together with special measures adopted to deal with problems peculiar to certain areas, and notes are given on such related points as legislation, propaganda and cost.

The larvicide most generally used is diesel oil mixed with 2½ per cent. of its volume of cresol, but Paris green mixed with powdered soapstone is applied in certain circumstances. For controlling larvae drifting on moving water, screens made of a tough kind of grass that grows to a height of 10–15 feet are fixed between stakes placed across drains, irrigation channels, etc., with their lower edges several inches below the water surface so that they trap the floating larvae without seriously impeding the current [*cf.* **23** 195]. Chaff soaked in the oil-cresol mixture is thrown on the water above the boom so that the larvae held up by the latter are killed by the exuding oil. For waterways in which the level of the moving water changes, similar booms are used, but the screens are made so that they can be rolled up like blinds between the stakes ; thus when the water is low only the central one of three may be needed and in any case they can all be rolled up or down so that their lower edges are at the required level below the water surface. A rope is stretched across the water above the boom to catch floating objects that might damage it. In cases in which there is a great variation in the amount and velocity of the water at various times, promising results have been obtained by using short booms that project only a few feet from the banks at points where observation has shown that the current becomes sufficiently sluggish to allow the accumulation of drifting larvae. Chaff soaked in oil is scattered on the upstream side of these booms. All oil booms require a certain amount of attention, but their use leads to an economy in oil and they have proved to be the most effective method of dealing with larval drift.

The sewage farm that was in part responsible for the abundance of *Culex fatigans*, Wied., in spring [*cf.* **26** 232] was closed in the autumn of 1938. Control of Culicine breeding in the underground drainage system has been increased by placing a series of iron plates across the beds of the drains at intervals of about 200 yards to hold up the oil and so enable it to act on the larvae. A space of about 6 inches is left between the lower edge of the plate and the bed of the drain, and a sliding gate that can be removed if the current is strong and is subjected to too much obstruction is fitted in the centre of the plate.

In certain parts of the urban area, very promising results have been obtained by using a pyrethrum spray to destroy Anophelines in houses [**26** 180], and it is probable that the extension of this method to other parts of the area will be the principal additional defence measure adopted during the next epidemic year.

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Covell (G.) & Harbhagwan (—). **Malaria in the Wynaad, South India.** —*J. Malar. Inst. India* **2** no. 4 pp. 341–376, 1 map., 10 refs. Calcutta, 1939.

An account is given of investigations carried out between January 1938 and May 1939, inclusive, on malaria on the Wynaad Plateau, southern India. The physical features, climate and population of the Wynaad are described [*cf. R.A.E.*, B **2** 193], and the history of malaria there is reviewed. The number of malaria cases treated at various dispensaries between 1934 and 1938 showed a well-marked peak in May or June of each year. In two instances, there was a small rise in August. In collections of Anophelines made in several localities, 19 species were taken either as adults or larvae. In dwelling houses, Anophelines were found in small numbers only from September to March ; they were most abundant in May and there was a marked decline in June. In one station, *Anopheles fluviatilis*, James, constituted 69 per cent. of the total catch from April to December and 61 per cent. from January to May, while at another, it constituted 78 per cent. of the catch between 29th March and 11th June. On the other hand, the percentages of this species caught in cattle sheds in periods including all months of the year were only 0·5–1·4. During the period under review, 11,930 Anophelines were dissected, but only *A. fluviatilis* was found infected. The infection rate in the females of this species taken in houses was 20 per cent. for the whole period and exceeded 26 per cent. in June 1938 and April 1939. Out of 112 individuals taken in cattle sheds, 3 were infected. The gut contents of 1,681 females of *A. fluviatilis* out of 2,289 examined yielded positive results with the precipitin test, and 96·91 per cent. of them had fed on man. Less than 5 per cent. of the females of other species taken from houses and showing positive results contained human blood.

Larvae of *A. fluviatilis* were abundant in rice-field drainage channels, especially from April till the onset of the rains in June, and also occurred in streamlets and in smaller numbers in larger streams with moderate current and grassy edges or among clumps of vegetation growing in the bed of the stream. They were present also in wells in the monsoon season (August and September) when the water was almost at ground level and contained *Spirogyra*. They were never found in drains or streams with bare edges, in swamps or marshes under natural conditions, in water draining from these or in rice-fields. Sunlit breeding places were preferred, but larvae were also found in waters that were partly shaded. Breeding places were invariably near dwellings.

Tests of the value of packing drainage channels from rice-fields [*cf.* **25** 46, etc.] were carried out in 1938 and 1939. In experiments in which *Schumannianthus virgatus* and mixtures of 5 and 11 kinds of herbage were used, very encouraging results were obtained, no larvae of *A. fluviatilis* being taken in the packed portion, though they were found above and below it. To prevent the herbage from being washed away by the first heavy rains, it had to be held in place by means of stakes and cross-pieces. Packing with *Lantana* or bamboo was not effective. The water in packed drains became dark brown and covered with an oily-looking film, but no particularly offensive odour was noticed. It is suggested that all rice-field drains within half a mile of dwellings should be packed by the end of February of each year, and the packing kept in place until the onset of the rains in June.

Where there is a sufficient fall, smaller streams may be treated by flushing or, if this is not practicable, the edges of the streams for half a mile above and below habitations should be kept clean weeded and clumps of vegetation in the stream-bed removed. Larger streams should also be treated in this way. It is suggested that the use of sprays to destroy the adult mosquitos in houses may be of value, and other measures should include regulations to prevent the drainage of swamps or the cutting down of vegetation that shades streams.

Senior White (R.) & Adhikari (A. K.). **On Malaria Transmission around the Chilka Lake.**—*J. Malar. Inst. India* **2** no. 4 pp. 395–423, 1 graph, 2 figs., 4 pls., 15 refs. Calcutta, 1939.

Descriptions are given of the Chilka Lake in Orissa and the composition of the lake water, and previous investigations on malaria in the neighbourhood are reviewed. Spleen rates had shown that there was a close relation between proximity to the lake and the degree of malarial endemicity, but only very widely distributed species of Anophelines had been found round the lake up to 1932, and dissection had failed to reveal the vector. *Anopheles sundaicus*, Rdnw., the only species of which the bionomics would account for the facts observed, had been searched for without result. An epidemic of malaria occurred on the western shore of the lake in 1936 [*R.A.E.*, B **25** 254], and *A. sundaicus* was first taken in villages near the lake in the spring of 1937. Anophelines from five localities were dissected during the next 12 months. In 425 females of *A. sundaicus* from three southern localities in Rambha Bay, 10 gut infections and 5 gland infections were found; females of 8 other species were dissected, but none was infected. At the two localities further north, 234 females of *A. sundaicus* were not infected, but one gut infection was found among 25 of *A. aconitus*, Dön., and 3 gut infections among 362 of *A. annularis*, Wulp. As *A. annularis* and *A. aconitus* are known vectors on the Orissa coastal plain north of the Mahanaddi delta, it is probable that they play some part in transmission round the lake, but it appears fairly certain that *A. sundaicus* is responsible for the large amount of malaria in a belt about half a mile wide at least at its southern end.

The principal under-water plants in the lake are *Potamogeton pectinatus* and *Halophila ovata*, which grow in large beds. They may be uprooted by wave action from May onwards. Until September the dead plants are cast ashore, but from October the floating débris is bound into masses by an alga (*Lyngbya aestuarii*) and forms wide belts that may completely cover the channels between the mainland and the islands and fill the mouths of streams. In spring, the algal masses are collected for manure. Between them, Anopheline larvae are found at a density of as much as 200 per dip, but two collectors working among larvae at this density in April took three hours to obtain about 100 pupae. It is suggested that the pupae, which dive when disturbed, re-emerge beneath the masses, in which they are held and drowned. The larvae taken were *A. subpictus*, Grassi, and *A. sundaicus* in varying proportions. *A. sundaicus* was not found from May to September, when the weed belts were absent as the result of collection or wave action. It was found breeding inland from the shore-line only in waters that were periodically subject to mixture with lake water. The inshore area invaded is narrow, but the density of breeding in it may be considerably greater than that in the lake itself, and

water in such areas yields a higher proportion of *A. sundaicus* in relation to *A. subpictus* than does the lake. However, the much greater area of breeding at the edge of the lake probably renders it a more important source of *A. sundaicus*, so that it would be essential to deal with it in any form of larval control.

The author discusses at some length the probable time of introduction of *A. sundaicus* into the region of Chilka Lake, but reaches no definite conclusions.

Strickland's suggestion that malaria on the shore of the lake might be controlled by closing the existing outlet during the dry season, in order to allow the inflowing rivers to raise the water level and destroy the breeding places in the shallow water on the foreshore [**27** 9], is criticised. It is pointed out that the object would not be achieved, as the breeding occurs in the floating algal belts. Moreover, rice-growing areas would be rendered useless and pisciculture adversely affected by the substitution of fresh-water fish for the valuable marine species that are now found in the lake. It is considered that any attempt to suggest a remedy for the malaria of the Chilka is premature.

RUSSELL (P. F.) & MOHAN (B. N.). **On experimental Malaria Infections in certain** *Anopheles* **of South-eastern Madras.**—*J. Malar. Inst. India* **2** no. 4 pp. 425–431, 13 refs. Calcutta, 1939.

In experiments to determine the degree of susceptibility of different species of mosquitos to infection with malaria parasites, a standard of comparison is desirable. In this paper, the results are given of experiments on the infection of *Anopheles stephensi*, List., reared in different types of water [*cf. R.A.E.*, B **28** 44, 113] and of 6 other Indian mosquitos, principally with *Plasmodium falciparum*. They are not based on sufficient dissections to permit of definite conclusions on the susceptibilities of the species other than *A. stephensi*, but are thought to justify the suggestion that *A. stephensi* (type) from a tap-water larval environment may be used as a standard to gauge the significance of experimental infections of other species in India. It is distributed throughout India, has been reported naturally infected from many districts, is easy to work with, adapts itself to varying environments, feeds readily on man, cattle, monkeys and sparrows, and is highly susceptible to experimental infection. Simultaneous feeding and identical handling in experimental infections would eliminate the difficulties connected with the standardisation of gametocytes.

RUSSELL (P. F.) & MOHAN (B. N.). **Insectary Colonies of** *Anopheles stephensi* **(Type).**—*J. Malar. Inst. India* **2** no. 4 pp. 433–437, 2 pls., 7 refs. Calcutta, 1939.

A laboratory colony of *Anopheles stephensi*, List., reared in tap-water, has been maintained for more than a year in Madras, and sub-colonies have been maintained in cow-dung water and sullage water [*R.A.E.*, B **28** 44, 113]. The colony was started with 25 larvae collected from house wells in Madras City. Two attempts to obtain colonies from larvae of *A. stephensi* race *mysorensis*, Sweet & Rao, received from Bangalore, were unsuccessful.

To maintain the colony of *A. stephensi*, eggs were removed every morning from the small glass bowls of water in which they were laid in the colony cages, and floated inside paraffined cork rings in large

basins or tubs of tap-water. Hay infusion and small amounts of a mixture of litmus milk and dehydrated blood serum (2 : 1) were added occasionally, and the water was aerated once a day by means of a rubber bulb attached to a glass tube. The pupae, which were obtained continuously and in numbers in the basins and tubs, were put into the cages from which the eggs had been taken. When females were given the opportunity of ovipositing in bowls of tap-water, sea water and cow-dung water, eggs were recovered in practically equal numbers from the cow-dung water and tap-water, but only on two occasions were any found in sea water. No variations were seen in the diagnostic characters of the clypeal hairs of random samples of larvae from tap water, cow-dung water or sullage water. Rate of growth seemed about equal, but the larvae from cow-dung water appeared to be the least, and those from sullage water the most, robust. Development from egg to adult took 5–9 days, and the period of gestation was 5–6 days. It was only a little longer in the brief cold season than during the rest of the year. By the end of March 1939, the tap-water colony had passed through at least 40 generations. The colony cages were wooden boxes with sides 2 ft. square and a wire-screen front with a cloth-sleeve entrance. The relative humidity was kept high, preferably above 70 per cent., by means of bags of wet sand and pieces of wet cloth suspended in the cages. Glucose-water (10 per cent.) on cotton-wool was kept in each cage and a rabbit was put in every night.

A brief account is given of some observations on swarming and pairing in the insectaries, including attempts of males to pair with males, and swarming of males in the colony cages and bobbinet cages measuring 1 ft. cube, even in the absence of females. Experiments are recorded which indicate that in this species pairing is not necessarily dependent on ovarian development, a blood meal is not essential for successful pairing, pairing may take place with multiparous females, though whether re-fertilisation occurs is not known, and males of *A. stephensi* will attempt to mate with females of other species, and succeeded in doing so with females of *A. annularis*, Wulp.

Sicé (A.), Sautet (J.) & Ethes (Y.). **L'un des plus redoutables vecteurs du paludisme en Afrique, l'*Anopheles gambiae* Giles, 1902, est-il susceptible d'être transporté en France par les avions ?**—*Rev. Méd. Hyg. trop.* **31** no. 4 pp. 137–139. Paris, 1939.

Females of *Anopheles gambiae*, Giles, sent by air mail from the French Sudan on 7th June were alive on arrival at Marseilles three days later. Some of them oviposited, and a generation was reared from egg to adult in about a fortnight at the temperature normally prevailing at Marseilles in June. The resulting females fed readily on man and paired. It thus appears that this dangerous vector of malaria might be introduced into France by aircraft and become established in the Provençal region, at least during the warm weather.

Svensson (R.). **A Handbook of Malaria Control.**—Cr. 8vo, viii+73 pp., 6 pls., 13 figs., many refs. [London] The Shell Group of Oil Companies [1940]. *Gratis.*

This booklet is primarily intended to assist men in charge of malaria control on estates, plantations and mines in the tropics. In the first half (pp. 1–35), brief notes are given on the economy of controlling

malaria, the nature of the disease, the appearance and habits of the Anopheline vector, the factors to be considered when planning control, the various types of measures that may be employed against Anopheline larvae, including natural measures, regulation of water flow or level, draining, and oiling, and the use of sprays against the adults. The second half consists of appendices dealing with the collection, maintenance, identification and dissection of adult mosquitos, the collection, rearing and mounting of larvae, the precipitin test, the measurements of humidity, laboratory equipment, useful weights and measures, and the vector species of the different zoogeographical regions, with lists of the works consulted.

ADAMS (P. C. G.). **Some Observations on the Flight of stained Anophelines at N'Kana, Northern Rhodesia.**—*Ann. trop. Med. Parasit.* **34** no. 1 pp. 35–43, 1 map, 9 refs. Liverpool, 1940.

Details are given of experiments on the flight range of *Anopheles funestus*, Giles, and *A. gambiae*, Giles, carried out in 1939 in a locality in Northern Rhodesia, where adult Anophelines were constantly found in native huts to the windward of a town in spite of the fact that measures against the larvae had been carried out over the usual distance of ½ mile from the edge of the inhabited area since 1929 and that the controlled area had been gradually increased to a distance of 1½ miles on the windward side. The prevailing winds blow from between east and south, that is, directly from a river 3 miles to the east of the town. Permanent breeding places of *A. funestus* in which heavy breeding occurred, were found along the banks of the river. Recapture of stained mosquitos released at various points showed that *A. funestus* can travel 4·3 miles down wind and 4·5 miles at an angle of 45° to the wind, 1·8 miles at right angles to the wind, and 1·5 miles against a wind of 4–7 miles per hour; and *A. gambiae* 4·25 miles down wind and 1·5 miles at an angle of 30° against a wind of 4–7 m.p.h. If mosquitos travelling 3 or 4 miles into a controlled area are already infected, they may affect the malaria incidence. In this case the menace may be overcome by controlling the adults with insecticidal sprays at the source of infection, or by removing the source of infection.

NICHOLAS (W. A.). **A four-day automatic Sluice.**—*J. Malaya Br. Brit. med. Ass.* **3** no. 1 pp. 44–46, 1 plan. Singapore, 1939.

A description is given, with a plan to scale, of an automatic siphon sluice for use in the control of Anopheline larvae in streams. It is simple in design, and requires no metal parts except a length of lead piping with an adjustable cock. It can be built on small streams and can be made to operate regularly at intervals of four or more days, which overcomes the objection raised against "unregulated" automatic types that constant sluicing causes soil erosion. It consists of a large reservoir divided from a smaller one by a concrete wall through which passes the lead piping. The cock can be adjusted so that the small reservoir is filled from the large one in four or more days. A ½-inch inverted U siphon connects the small reservoir with the outfall chamber and is joined at the top by means of a ½-inch tube with the top of a 6-inch inverted U siphon that connects the larger reservoir with the outfall chamber. When the small reservoir becomes nearly full (on the fourth or other selected day), the water flows

through the smaller siphon, and the air is sucked from the air-lock in the larger siphon. When the air-lock has thus been destroyed, the water in the large reservoir is suddenly released.

Roy (D. N.). **Influence of Spermathecal Stimulation on the Physiological Activities of** *Anopheles subpictus*.—*Nature* **145** no. 3680 pp. 747–748, 2 refs. London, 1940.

Anopheles stephensi, List., and *A. annularis*, Wulp, pair in ordinary feeding cages in the laboratory, but *A. subpictus*, Grassi, does not. The ability of all three species to feed on blood is independent of pairing, but *A. subpictus* does not feed to the same extent as in nature. A blood-meal leads to egg formation in virgin females of *A. stephensi* and *A. annularis*, but fails to do so in those of *A. subpictus*. Collections of *A. annularis* and *A. subpictus* were made from the salt-lake area adjacent to Calcutta during the winter months, and about 500 of each were dissected. The author has already suggested that there are two distinct phases in egg formation in *Aëdes aegypti*, L., one stimulation of the follicle and the other formation of the ovum [*R.A.E.*, B **25** 38]. The ingestion of blood causes follicular stimulation and yolk formation in *Anopheles annularis*, but only follicular stimulation in *A. subpictus*; yolk formation in the latter species does not take place until sperm is introduced into the theca.

Sundar Rao (S.) & Maplestone (P. A.). **The Adult of** *Microfilaria malayi* **Brug, 1927.**—*Indian med. Gaz.* **75** no. 3 pp. 159–160, 2 figs. Calcutta, 1940.

Adults of both sexes of *Filaria* (*Wuchereria*) *malayi* are described. Two males and two females were obtained in North Travancore from a cyst on the arm of a patient showing microfilariae of *F. malayi* in the blood and in the lymph from the cyst. No microfilariae of *F.* (*W.*) *bancrofti* were seen in the blood or lymph. The female is indistinguishable from that of *F. bancrofti*, but there are slight differences in the males, and these, in addition to differences between the microfilariae that have been recognised for many years and to the fact that the mosquito hosts are not the same, lead the authors to conclude that the two species are distinct.

Kennedy (J. S.). **The Visual Responses of Flying Mosquitoes.**—*Proc. zool. Soc. Lond.* (A) **109** pt. 4 pp. 221–242, 5 figs., 27 refs. London, 1940.

The following is substantially the author's summary: Observations were made on females of *Aëdes aegypti*, L., that had not had a blood meal. When suspended by a silk fibre, they orientated themselves inaccurately but consistently away from the source of a horizontal beam of artificial light. They orientated themselves accurately towards a vertical black stripe on a white background and would rotate, maintaining this position when the stripe was rotated around them at rates of up to 25 revolutions per minute. Mosquitos presented with two black stripes faced one or other stripe, and not between the two. Light stimulation of the front part of the eye evoked a more powerful turning-away response than stimulation of the sides. The mosquitos were attracted by and followed stripes that were moving,

abandoning stationary similarly striped or darker walls to do so. Unsuspended, freely flying mosquitos in a wind tunnel orientated themselves consistently up wind, keeping position or making headway so long as the background was visible, but not in darkness. Without a wind, but with transverse stripes moving along the floor, they flew with or ahead of the stripe movement, the visual equivalent of flying up wind. The above evidence that up-wind orientation involves a visual "compensation" mechanism is discussed, and a theory of the mechanism put forward. The lateral ommatidia initiate the responses to light and to moving objects, working in a different way from the dorsal and ventral ommatidia, which are concerned in up-wind orientation. Interplay between the two classes of response may take place.

Bos (A.) & Nieschulz (O.). **Einige weitere Versuche mit überwinternden Exemplaren von** *Culex pipiens*. [Some further Experiments with hibernating Individuals of *C. pipiens*.]—*Zool. Anz.* **129** pt. 5–6 pp. 151–153. Leipzig, 1940.

Following investigations in Holland on feeding and oviposition by *Culex pipiens*, L., at the end of the hibernation period [*R.A.E.*, B **19** 229], similar observations were carried out in 1938 at the beginning of the hibernation period. The mosquitos were caught in a cellar and caged with fowls for one night, either immediately or after having been kept for 3 or 6 days at 27°C. [80·6°F.] to cause depletion of the fat reserve. From 4th October to 22nd December, a total of 1,721 mosquitos were tested in 18 batches. The percentages that sucked blood were 19 for mosquitos placed immediately with fowls, and 45 and 71 for those kept for 3 and 6 days at 27°C. Of the mosquitos that had sucked blood, 121 were kept at a warm temperature (between 22 and 30°C. [71·6 and 86°F.]) and 130 at room temperature. They were given water, but no food. Of the two lots, 62 and 59 oviposited, and the resulting larvae developed normally.

Pinto (C.). **Disseminação da malaria pela aviação; biologia do** *Anopheles gambiae* **e outros anofelineos do Brasil.** [The Spread of Malaria by Aviation; the Biology of *A. gambiae* and other Anophelines of Brazil.]—*Mem. Inst. Osw. Cruz* **34** pt. 3 pp. 293–430, 35 figs., 61 pls., many refs. Rio de Janeiro, 1939. (With a partial Summary in English, p. 342.) [Recd. 1940.]

Malaria has become a major problem in Brazil since the introduction, at some date between August 1928 and February 1930, of *Anopheles gambiae*, Giles, into the State of Rio Grande do Norte [*cf. R.A.E.*, B **27** 125, 218]. The crossing from Dakar (Senegal) to Natal (Brazil), takes 10½ hours by aircraft and 70 by express steamboat, and it is believed that adults of *A. gambiae* were brought over in the steamboats. A summary is given of data on mosquitos found in aircraft at Miami [*cf.* **27** 215], and the dissemination of *A. gambiae* in Brazil by aircraft is considered very possible.

A key is given to the genera and subgenera of Brazilian Anophelines of medical importance, followed by descriptions of the larva and adults of *A. gambiae* taken in Brazil, and of the diagnostic characters of the egg and pupa. Observations on the development of *A. gambiae*, the main results of which have already been noticed [**27** 218], were carried out by the author in 1938–39. Females taken in houses were

allowed to oviposit in fresh water in December 1938, and the larvae were kept at 21–30°C. [69·8–86°F.] and exposed to sunlight, which was necessary for development, every day. Small pieces of roots of *Pistia stratiotes* were supplied as food, and after 8 days, when the larvae reached the fourth instar, bread crumbs and fragments of the thorax of flies (*Musca domestica*, L.). One larva in the last instar was observed to feed on crumbs for 66 minutes without coming to the surface. The chief breeding places of *A. gambiae* were collections of fresh water that was still, clear, exposed to sunshine, and covered partly or completely with aquatic vegetation in which *Pistia stratiotes* predominated, drinking places for animals, pools left in dry river beds, troughs sunk in the ground, and small streams with a gentle flow. Larvae of Anophelines of the *Nyssorhynchus* group that were found in Rio Grande do Norte in November, December and January associated with *A. gambiae* were, in order of abundance, *A. albitarsis*, Arrib. (which is very common), *A. argyritarsis*, R.-D., *A. tarsimaculatus*, Goeldi, and *A. triannulatus*, Neiva & Pinto. Larvae of other mosquitos were rare, only a few of *Aëdomyia squamipennis*, Arrib., and *Culex* sp., being associated with those of *A. gambiae*. The males and females of *A. gambiae* were common in huts and houses, where the latter attacked man, and were not taken out of doors. They sheltered in dark places, behind furniture, high up on walls and on ceilings, etc. The behaviour of the adults in other parts of the world is summarised from the literature.

The remainder of the paper comprises keys to the males and females of Anophelines of the *Nyssorhynchus* group that are of medical importance in Brazil, a key to the larvae of these species and of *A. gambiae*, a detailed review of the literature on them, including extensive bibliographies, descriptions of all known stages, biological data and records of relation to malaria, and brief descriptions of the adult characters of some Anophelines of other groups.

LUTZ (A.). **The Transmission of Leprosy by Mosquitos and its Prophylaxis.**—*Mem. Inst. Osw. Cruz.* **34** pt. 4 pp. 485–493, 7 refs. Rio de Janeiro, 1939. (Also in Portuguese pp. 475–484.) [Recd. 1940.]

The author summarises the evidence in favour of the transmission of leprosy by mosquitos [*cf. R.A.E.*, B **24** 234], outlines a programme of experiments designed to demonstrate it, and describes precautions against mosquitos that should be taken in leper hospitals and settlements.

DE BEAUREPAIRE ARAGÃO (H.). **Observações a respeito de um foco limitado de Febre Amarela Silvestre no Estado de São Paulo.** [Observations in Connection with a restricted Focus of Jungle Yellow Fever in the State of São Paulo.]—*Mem. Inst. Osw. Cruz.* **34** pt. 4 pp. 495–518, 1 map. Rio de Janeiro, 1939. [Recd. 1940.]

An account is given of a localised outbreak of jungle yellow fever that occurred in a municipality comprising several settlements on the River Paraná, in western São Paulo, Brazil. The first cases were observed in December 1937, and the last in February 1938. There had been a previous outbreak in the locality at the end of 1936,

and as no cases were reported from June to December 1937 in the State or surrounding districts, it is considered probable that the virus was preserved in mosquitos or wild animals.

The disease was transmitted to rats and monkeys (*Macacus rhesus*) that were inoculated with the blood of infected persons, and there was some evidence that it was transmitted to two howler monkeys (*Alouatta*), through the results were not conclusive. It is pointed out that a great mortality among howler monkeys frequently precedes the appearance of cases of jungle yellow fever. Some observations on mosquitos were carried out, mostly in the jungle. They indicated that those that take blood during the day are females that are feeding for the first time. These are easily recognised by their empty abdomens and intact scales. Numerous engorged females were found sheltering on low vegetation in damp sites, but only one that had already taken blood was observed attacking man by day. It is concluded, therefore, that cases of the disease contracted during the day are due to contact with the virus in the excreta expelled by infected mosquitos [*cf.* *R.A.E.*, B **17** 237] on vegetation, etc. At laboratory temperatures, the excreta of infected mosquitos remained virulent for a considerable time, and it is considered that in the jungle, where temperatures are lower and there is less light, they would do so for a much longer period. It is also possible that flies or other insects may become contaminated with the infected excreta on leaves and then deposit it on the human skin.

Of the 21 species of mosquitos that were common in the jungle, much the most numerous was *Aëdes scapularis*, Rond., which evidently plays an important part in the transmission of the disease [*cf.* **18** 166]. Anophelines were rare. *Aëdes aegypti*, L., and *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) occurred in the larger centres of population, but the stegomyia index in the chief centre was not higher than 1·5 per cent. and was therefore too low for cases of urban yellow fever to occur [*cf.* **26** 42]. In the previous year, the index had been 22 per cent. and cases of urban yellow fever were reported in April.

de Beaurepaire Aragão (H.). **Mosquitoes and Yellow Fever Virus.**—*Mem. Inst. Osw. Cruz* **34** pt. 4 pp. 565–581. Rio de Janeiro, 1939. (Also in Portuguese pp. 547–563.) [Recd. 1940.]

From a review of data on urban, rural, and jungle yellow fever in Brazil, the author concludes that they are the same disease as regards clinical aspects, lesions, and immunological reactions, and differ only in epidemiology. *Aëdes aegypti*, L., is the sole vector of the urban and rural forms, and the jungle form results from the adaptation of the virus to other mosquitos. This adaptation is fairly recent, for the first foci of jungle yellow fever were observed in Bolivia in 1887 and only of late years has it increased greatly in South America, this being due to the development of motor traffic. A greater adaptation of the virus seems now in progress. It does not maintain itself for more than about 8 days in some jungle mosquitos (including *Psorophora discrucians*, Wlk., in the author's experiments), whereas it multiplies well in others, but it is not transmitted by their bites. Certain species, however, including *Aëdes scapularis*, Rond., *A. fluviatilis*, Lutz, *A. leucocelaenus*, Dyar & Shannon, and *Haemagogus capricorni*, Lutz,

become infected readily and transmit the virus by biting just as *A. aegypti* does.

Temperature has an important influence on the epidemiology of yellow fever transmitted by jungle mosquitos and by *A. aegypti*. During epidemics of jungle yellow fever in the elevated plateau zone in the States of São Paulo, Goyaz, Minas and Paraná, at altitudes of 1,600 to 3,200 ft., no foci were formed in the towns infested by *A. aegypti*, though they received from the forests patients still in the first three days of the disease. This has been interpreted as a proof that jungle yellow fever differs from the classic urban form, but is really due to the effect of temperature on *A. aegypti*. The vital optimum of this mosquito lies between 27 and 32°C. [80·6 and 89·6°F.], and all its vital activities are retarded at temperatures between 25°C. [77°F.] and 17°C. [62·6°F.], and cease at lower temperatures. In the plateau region, the average summer temperature is usually between 22 and 24°C. [71·6 and 75·2°F.] and rarely higher. At such temperatures, the duration of all stages of *A. aegypti* is prolonged, the egg stage lasting 20 days. The females do not oviposit until 18–20 days after the first blood-meal, and when they have done so, most of them die without feeding again. Low temperatures also reduce the multiplication of the virus in this mosquito and prolong the time it requires to reach the salivary glands. In São Paulo there are in summer low night temperatures of 16–18°C. [60·8–64·4°F.], which are very harmful to *A. aegypti*. Epidemics of urban yellow fever have been severe in the past, but only when the stegomyia indices were very high, and opportunities for breeding were very numerous. They still occur occasionally, as was observed at Presidente Vencesláu in 1937, when the stegomyia index was 22 per cent. in April [see preceding abstract], but are not extensive. The importance of temperature in reducing the risk of urban yellow fever on the plateau zone is confirmed by evidence cited that outbreaks of jungle origin occur readily in towns at low altitudes where the warm climate renders conditions favourable for *A. aegypti*.

Jungle mosquitos require much less warmth than *A. aegypti*; a temperature of 20°C. [68°F.] or a little more provides favourable conditions for them, and the virus multiplies in them at this temperature. It therefore appears that the multiplication of the virus in a mosquito depends, not directly on temperature, but on the more or less perfect adaptation of the mosquito to a given thermal level.

In a final section, the author discusses the ways in which jungle mosquitos transmit the disease to man. Transmission by biting occurs only at night, but infection can be acquired during the day by contact with infected faecal droplets excreted by the mosquitos [see preceding abstract].

LENT (H.). **Sobre o hematofagismo da** *Clerada apicicornis* **e outros artropodos ; sua importancia na transmissão da doença de Chagas.** [On Blood-sucking by *C. apicicornis* and other Arthropods. Its Importance in the Transmission of Chagas' Disease.]—*Mem. Inst. Osw. Cruz* **34** pt. 4 pp. 583–606, 4 figs., 9 pp. refs. Rio de Janeiro, 1939. [Recd. 1940.]

This paper includes comments on conclusions by Castro Ferreira & Deane regarding the importance of *Clerada apicicornis*, Sign.,

as a vector of *Trypanosoma cruzi* [*cf. R.A.E.*, B **28** 58], the original description and a re-description of this Lygaeid, and lists of first records of Triatomids found naturally infected with *T. cruzi*, and of insects and ticks experimentally infected with this trypanosome.

Neiva (A.), Pinto (C.) & Lent (H.). **Notas sobre triatomideos do Rio Grande do Sul e descrição de uma nova especie.** [Notes on Triatomids of Rio Grande do Sul and Description of a new Species.]—*Mem. Inst. Osw. Cruz* **34** pt. 4 pp. 607–610, 2 figs., 5 refs. Rio de Janeiro, 1939. [Recd. 1940.]

Records are given from the literature of Triatomid bugs in Rio Grande do Sul, together with a description of *Triatoma* (*Eutriatoma*) *oliveirai*, sp.n., from a single female taken in this State.

Lent (H.) & Pifano C. (F.). **Dados experimentais sobre a infestação do** *Eutriatoma nigromaculata* (**Stal, 1872**) **pelo** *Schizotrypanum cruzi* (**Chagas, 1919**), **e sua redescrição.** [Experimental Data on the Infection of *Triatoma nigromaculata* with *Trypanosoma cruzi*, and a Re-description of the Triatomid.]—*Mem. Inst. Osw. Cruz* **34** pt. 4 pp. 627–635, 2 figs., 20 refs. Rio de Janeiro, 1939. [Recd. 1940.]

A brief account is given of experiments in October 1938 showing that *Trypanosoma* (*Schizotrypanum*) *cruzi* is able to develop in the digestive tract of *Triatoma* (*Eutriatoma*) *nigromaculata*, Stål. In December, nymphs and adults of this Triatomid naturally infected by *T. cruzi* were taken in a dwelling at an altitude of about 2,500 ft. in the State of Yaracuy, Venezuela. Trypanosomes morphologically resembling *T. cruzi* were recovered from the peripheral blood of two guineapigs 22 days after a suspension of the rectal contents of naturally infected bugs had been inoculated into them. Since the type specimen of *T. nigromaculata* (a female) has apparently not been traced since it was described, the original description is quoted, and both sexes are re-described from examples taken in 1938.

Reis (J.). **Alguns parasitas de** *Gallus gallus* (**L.**) **verificados em São Paulo.** [Some Parasites of Fowls found in São Paulo.]—*Arq. Inst. biol.* **10** pp. 147–152, 2 figs., 1 pl., 16 refs. S. Paulo, 1939. (With a Summary in English.) [Recd. 1940.]

Records are given of the occurrence on domestic fowls in the State of São Paulo, Brazil, of 4 mites, based on the examination of over 6,000 birds. *Rivoltasia bifurcata*, Rivolta, was observed causing a mild type of mange in one of them, while *Dermanyssus gallinae*, DeG., which in Brazil is usually found on cage-birds [*cf. R.A.E.*, B **28** 19], was taken on two occasions. Heavy infestations of *Mégninia ginglymura*, Mégnin, which is usually recorded on turkeys, pheasants and peacocks, were observed twice. Small calcareous formations of variable size occurred in the subcutaneous connective tissue of a number of the fowls, but *Laminosioptes cysticola*, Vizioli, which is associated with such formations, was found once only.

Pescott (R. T. M.) & Clinton (H. F.). **Poultry Pests.**—*J. Dep. Agric. Vict.* **37** pt. 12 pp. 568–574, 579, 14 figs., 2 refs. Melbourne, 1939. [Recd. 1940.]

Brief notes are given on the bionomics and control of the principal Arthropod parasites of poultry in Victoria, namely the lice, *Menopon gallinae*, L., *Lipeurus caponis*, L., *Gallipeurus* (*L.*) *heterographus*, Nitzsch, *Eomenacanthus stramineus*, Nitzsch, *Goniocotes gigas*, Tasch., *G. gallinae*, Retz., and *Goniodes dissimilis*, Nitzsch, the fowl tick, *Argas persicus*, Oken, and the mites, *Dermanyssus gallinae*, DeG., *Cnemidocoptes mutans*, Robin & Lanquetin, and *C. laevis* var. *gallinae*, Railliet, and of the flea, *Echidnophaga gallinacea*, Westw., which has not yet been found in Victoria, but is present in other parts of Australia [*cf. R.A.E.*, B **27** 205] and might be introduced.

Pemberton (C. E.). **Entomology. Parasite of Black Widow Spider.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1938–39* pp. 26–27. Honolulu, 1939. [Recd. 1940.]

A new and apparently specific egg parasite of the black widow spider [*Latrodectus mactans*, F.], discovered by W. Dwight Pierce in California in 1938, was introduced into Hawaii in August 1939. The parasites arrived in good condition and were liberated on the islands of Oahu, Maui and Hawaii. Some are being bred in the laboratory to enable further liberations to be made. The bite of the spider is painful and even dangerous, but few persons in Hawaii have as yet been bitten.

Underhill (G. W.). **Two Simuliids found feeding on Turkeys in Virginia.**—*J. econ. Ent.* **32** no. 6 pp. 765–768, 2 refs. Menasha, Wis., 1939. [Recd. 1940.]

Since it has been shown that *Simulium nigroparvum*, Twinn, transmits a protozoan disease of turkeys in Virginia [*cf. R.A.E.*, B **26** 188], which is here definitely stated to be due to *Leucocytozoon smithi*, a study is being made of the species of Simuliids that attack turkeys in this State. Adults were reared from larvae, pupae and cocoons collected in different types of streams in 64 counties at 687 different collecting stations, and adult females were collected by sweeping with a net or were taken while they were feeding on turkeys. Two species, were identified, *Simulium nigroparvum* and *S. slossonae*, Dyar & Shannon, but although the latter was taken on turkeys in 1937 and 1938, it was found only in the adult stage and only in one county. Details are given of the distribution and seasonal prevalence of *S. nigroparvum*, and the habits of the larvae and adults are described [*cf. loc. cit.*].

Fay (R. W.). **A Control for the Larvae of Houseflies in Manure Piles.**—*J. econ. Ent.* **32** no. 6 pp. 851–854, 7 refs. Menasha, Wis., 1939. [Recd. 1940.]

Investigations on *Musca domestica*, L., and its control in manure heaps were carried out during the summers of 1937 and 1938 on the farm of the University of Illinois at Urbana. Experiments showed that the life-cycle could be completed in 15–18 days. Eggs were deposited ½–1 inch below the surface of manure less than 2 weeks old ;

the droppings of horses and cattle alone seemed to be attractive. During development, the maggots remained close to the point of oviposition and required quite specific environmental conditions for the completion of development. Under field conditions, a temperature of 120°F. was found to be lethal, although maggots developed at temperatures as high as 110–116°F. if the medium was moist. Field droppings of animals dry out rapidly when exposed to the sun, and maggots are unable to complete their development in them except during rainy seasons. Examination of the physical properties of manure stacked in the field in summer showed that the temperature ranged from 140 to 170°F. through the interior of the piles up to within 8 inches of the surface and was 112–118°F. about 4 inches below the surface, regardless of the fluctuations in the temperature of the air. The larvae can thus survive only in the outer 4 inches. On the farm, the manure was divided into that consisting mainly of soiled bedding (light manure) and that composed of almost pure droppings (heavy manure). Few maggots were found in ricks of the former, so that the method of piling it was not important, whereas random counts gave an average of 250 maggots per sq. ft. of the top surface in the two ricks of heavy manure, and it was estimated that 500,000 flies per week were emerging. To reduce the surface area, the rick was formed by piling the manure to the final height of 9 feet over a small area instead of the usual method of covering the entire basal area of the rick to a depth of 3 feet before adding manure to the top of the pile. Much of the fresh manure was thus covered, and the temperature became lethal before the eggs and larvae had had time to develop.

Methods for treating the upper 5 inches of manure were then studied. After briefly reviewing the chemical measures that have been recommended and pointing out their disadvantages, the author describes two practical methods that were evolved. In the first, strips of standard 60-lb. roofing paper 16 feet long and 3 feet wide were laid over the top surface of a fresh part of the rick so that each overlapped the next by 3 inches and were held in place by bricks. The covering prevented loss of heat and also absorbed heat from the sun, so that the temperature just under the cover averaged 40°F. higher than that of the surrounding air. Thus, when the air temperature exceeded 80°F. for a period of 5 hours, all larvae in the covered area of the rick were killed. No adults emerged in the laboratory from pupae found in the covered area. The tar paper apparently changed the composition of the manure, possibly by altering its moisture content. The cover was removed after 4 days, but no further oviposition by house-flies occurred, and larvae placed in the rick failed to develop. As the manipulation of the individual strips required considerable time, a second method was tried. A double paper-covered burlap sheet 20 feet square impregnated with creosote oil was placed over the manure and held in place by stakes; it covered the top and extended for 2 feet down the sides. It took about 10 minutes to remove and replace the sheet when fresh manure was added. When the rick under the cover had been built to the desired height, the cover was left on for 5 days and then moved to a new pile. Only about 90 per cent. of the maggots were killed by this treatment. Since some of the maggots near the edge of the burlap were able to migrate and pupate in the ground, a ditch 6 inches wide and 6 inches deep was dug as close to the sides of the rick as possible. This ditch was filled within 12 hours by liquids seeping from the manure and trapped the migrating larvae,

a layer ½ inch deep of drowned maggots being found the day after the cover had been placed in position. The ditch beside the uncovered parts of the rick contained only a few scattered larvae ; most of the larvae pupated just under the surface of the uncovered manure and did not leave the pile. The decrease of adult flies in the area was very marked, and it was estimated that in the dairy barns they were reduced by 50 per cent.

MILLS (H. B.) & PEPPER (J. H.). **The Effect on Humans of the Ingestion of the Confused Flour Beetle.**—*J. econ. Ent.* **32** no. 6 pp. 874–875. Menasha, Wis., 1939. [Recd. 1940.]

The experiments described were carried out in response to a request for information concerning the possible injurious effects that might be caused by the ingestion of examples of *Tribolium confusum*, Duv., accidentally included in cereals. Both raw and cooked adults and larvae were fed to rats, and beetles, larvae, pupae, cast skins, eggs and excrement boiled in oatmeal were eaten by men without any subsequent indication of digestive disturbance, even though the number of beetles was far greater than would normally be eaten in infested cereals.

RILEY (W. A.). **The Possibility of Intestinal Myiasis in Man.**—*J. econ. Ent.* **32** no. 6 pp. 875–876, 3 refs. Menasha, Wis., 1939. [Recd. 1940.]

In connection with the question whether intestinal infestation of man by Dipterous larvae actually occurs or whether the numerous recorded cases can be explained by stool contamination, the author discusses the experiments carried out by O. R. Causey and the conclusions drawn from them [*R.A.E.*, B **27** 107]. He points out that a limited series of negative experiments do not disprove many detailed positive reports by careful physicians and entomologists who were well aware of the chances of error involved. Although there are undoubtedly many cases that can be justifiably accounted for by contamination, there are others that cannot be lightly dismissed. As an illustration of the latter, he quotes a case in which living larvae were discharged over a considerable period by a patient under the close supervision of a physician, who stated in reply to a question regarding the possibility of extracorporeal contamination that there was absolutely no chance of error in collecting the samples, which were obtained from defaecation, from vomitus and from the rectum through a proctoscope. Moreover, the author himself has seen a number of cases in which it was certain that living larvae (chiefly of species of *Sarcophaga*, but also of *Fannia* and *Eristalis*) were discharged from the human intestine.

GLASGOW (R. D.) & DEPORTE (P.). **Recovery from Excreta of the Pigeon of viable Eggs of the Giant Thorny-headed Worm of Swine.** —*J. econ. Ent.* **32** no. 6 p. 882. Menasha, Wis., 1939. [Recd. 1940.]

The senior author has found experimentally that eggs of *Macracanthorhynchus hirudinaceus* and other parasitic worms may be carried for considerable distances on the soiled feet of birds. To determine whether eggs of *M. hirudinaceus* could survive passage through

the alimentary canal of birds, the authors undertook the experiment here described, in which a pigeon was fed on food contaminated with eggs of the worm until such eggs appeared in its excreta. On 16th May 1938, Lamellicorn larvae were fed on small quantities of these excreta under conditions precluding their contamination with worm eggs from any other source. On 19th June, fully developed larval cysts of *M. hirudinaceus* were found in the body cavity of treated larvae, although no cysts were found in grubs from the same stock kept as controls. It therefore appears that birds that forage on land occupied by pigs may transport and disseminate in their excreta viable eggs of this worm that they have ingested with contaminated food.

Glasgow (R. D.) **Control of Blackflies (Simuliidae).**—*J. econ. Ent.* **32** no. 6 pp. 882–883. Menasha, Wis. 1939. [Recd. 1940.]

Pyrethrum extract in a petroleum-oil solvent emulsified according to a formula similar to that of the New Jersey mosquito larvicide [*cf. R.A.E.*, B **23** 205] has proved in field tests to be highly effective in eradicating Simuliid larvae from a section of a stream. It caused no evident harm to fish, aquatic birds, or other associated aquatic vertebrates, but destroyed insects that serve as food for fish. It is suggested that owing to its similarity, the New Jersey larvicide should be equally effective against Simuliids and equally harmless to aquatic vertebrates. The cost of the treatment, although moderate, would doubtless limit its use to the neighbourhood of dwellings or other places where the expense would be justified.

Papers noticed by Title only.

Ôuchi (Y.). **A new Species of** *Megarhinus* **Mosquito** [*yamadai*, sp. n.] **from Amami-Oshima, the southern Japan.**—*J. Shanghai Sci. Inst.* (3) **4** pp. 223–225, 1 pl., 10 refs. Shanghai, 1939. [Recd. 1940.]

Macfie (J. W. S.). **The Genera of Ceratopogonidae.**—*Ann. trop. Med. Parasit.* **34** no. 1 pp. 13–30, 8 refs. Liverpool, 1940.

Lavier (G.) & Ristorcelli (A.). **Localités nouvelles de Seine-et-Oise pour** *Phlebotomus perniciosus*.—*Ann. Parasit. hum. comp.* **17** no. 6 p. 592, 1 ref. Paris, 1940.

Ayroza-Galvão (A. L.) & Coutinho (J. O.). **Contribuição ao estudo dos flebotomus do estado de São Paulo.** *Flebotomus sallesi* **n. sp. (Diptera, Psychodidae).** [*Phlebotomus sallesi*, sp. n., from a fowl house in the State of São Paulo, Brazil.]—*Ann. Fac. Med. S. Paulo* **15** pp. 125–139, 4 pls., 14 refs. S. Paulo, 1939. [Recd. 1940.]

Pasricha (C. L.) & Panja (G.). **A simple and inexpensive Flea-proof Cage** [for use in experimental work on plague].—*Indian med. Gaz.* **75** no. 3 pp. 160–161, 1 fig. Calcutta, 1940.

Remlinger (P.) & Bailly (J.). **Présence dans une urine de néphrite hémorragique de Sarcoptidés** (*Glyciphagus cursor* [*domesticus*]) **à divers stades de développement.**—*J. Urol.* **48** no. 1 pp. 37–41. Paris, 1939. (Abstr. in *Bull. Inst. Pasteur* **38** no. 8 pp. 374–375. Paris, 1940.)

Finlayson (M. H.). *Harpactirella lightfooti* **as a Cause of Spider-bite in the Union. With a Note on the Biology of** *Harpactirella lightfooti* **(Purcell) by R. Smithers.** — *S. Afr. med. J.* **13** no. 24 pp. 808–810, 1 fig., 7 refs. Cape Town, 1939. [Recd. 1940.]

In the course of investigations on the spiders of South Africa that are poisonous to man [*R.A.E.*, B **25** 151], reports were received that bites producing severe illness were inflicted by "tarantulas." Specimens of the so-called tarantulas were obtained and were found to be spiders of the genus *Harpactira*. Since the bites of these spiders produced no symptoms in mice or guineapigs, the investigations were discontinued. In 1939, however, details of two cases of spider bite were received, together with examples of the spider, which was identified as *Harpactirella lightfooti*, Purcell. Though the genera *Harpactira* and *Harpactirella* belong to different families, they cannot be distinguished without microscopic examination. Mice bitten by examples of *H. lightfooti* rapidly developed convulsions, collapsed and died, and a guineapig showed various signs of distress and a few convulsions, but later recovered. Attempts to separate the venom were unsuccessful owing to its lability. Mice that had received antivenene prepared against *Latrodectus indistinctus*, P. Camb. [*cf. loc. cit.*] were protected against the full effects of the bite of *H. lightfooti*.

The four species of *Harpactirella*, a genus confined to South Africa, are hunting spiders and therefore come into contact with man more readily than spiders that spin webs. They are remarkably active and aggressive. The nests consist of silk-lined tunnels under stones, logs and other débris on the veldt.

Maister (M.) & Miller (A.). **Murine Typhus in Natal. I. Report of Occurrence of Case.**—*S. Afr. med. J.* **13** no. 24 p. 803. Cape Town, 1939. [Recd. 1940.]

Gear (J.) & De Meillon (B.). **Murine Typhus in Natal. II. Laboratory Investigations. (Report of the Isolation of the Virus of Murine Typhus from Rats, Rat Fleas and from a Human Case).**—*T.c.* pp. 804–806, 1 fig., 4 refs.

The occurrence of a case of typhus-like disease in Pietermaritzburg, Natal, in May 1939 is described in the first paper. The patient, who gave a history of having been bitten by insects on her arms and legs, was an employee in a large rat-infested grain store from which a similar case had been reported three years previously. Since it seemed possible that these were cases of murine typhus [*cf. R.A.E.*, B **23** 262], experiments described in the second paper were carried out with rats caught in the store. The virus was transmitted to guineapigs by inoculating them with emulsions of the brains of the rats and to a white rat kept in a jar for a fortnight with examples of *Xenopsylla cheopis*, Roths., taken from the rats, though whether transmission in the latter case was due to the bites of the fleas or to their ingestion by the rat is not known. The virus of murine typhus was also isolated from a man living next door to the grain store, who fell ill in September 1939. Cross-immunity tests in guineapigs showed that the viruses isolated from the rats, the fleas, and the man were immunologically identical, and that they were also immunologically identical with a strain isolated from rats in Cape Province.

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GEAR (J.) & DE MEILLON (B.). **The common Dog Tick** *Haemaphysalis leachi* **as a Vector of Tick Typhus.**—*S. Afr. med. J.* **13** no. 24 pp. 815–816, 2 figs., 3 refs. Cape Town, 1939. [Recd. 1940.]

Cases of tick-bite fever that appeared to have been acquired by contact with tick-infested dogs were recorded from the Witwatersrand in 1936, and the virus was subsequently transmitted to guineapigs by inoculation of a suspension of the organs of an example of *Haemaphysalis leachi*, Aud., taken from the ear of a dog belonging to a person who had suffered from the disease [*cf. R.A.E.*, B **28** 49]. Cases of tick-bite fever associated with dogs have continued to occur in considerable numbers on the Witwatersrand, and the experimental transmission of the virus to guineapigs by inoculation of ticks taken from dogs of patients has been successfully repeated three times. The experiments proved that *H. leachi* could harbour rickettsiae morphologically and immunologically identical with those causing tick-bite fever. In this paper is described an experiment in which examples of *H. leachi* taken from the dog of a patient in Somerset West, Cape Province, were allowed to feed on a guineapig, on which they became fully engorged in three days. Observations on this guineapig and on others sub-inoculated from it indicated that the virus had been successfully transmitted, and cross-immunity tests showed that this strain gave protection against tick-bite fever, but not against strains of epidemic or murine typhus.

BARLOVATZ (A.). **Typhus exanthématique de forêt au Congo.**—*Ann. Soc. belge Méd. trop.* **20** no. 1 pp. 23–40, 1 fig., 5 graphs, 15 refs. Brussels, 1940. (With Summaries in Dutch and English.)

An account is given of cases of typhus occurring in the tropical rain forest bordering the Congo River in the Belgian Congo. The disease appears to be endemic rather than epidemic. Although observations and experiments on the mode of transmission were inconclusive, they indicate that the vector is the body louse [*Pediculus humanus*, L.].

WOLFF (E. K.). **A Strain of Tropical Typhus recovered from Rat Fleas.**—*Ceylon J. Sci.* (D) **5** pt. 2 pp. 39–45, 1 chart, 1 diagr., 7 refs. Colombo, 1939. [Recd. 1940.]

A strain of typhus virus was isolated from fleas taken on rats caught on premises in Ceylon where a case of tropical typhus had occurred; both the human case and the strain of virus from the fleas belonged to the urban or shop type of Malaya [*cf. R.A.E.*, B **24** 29, 262, etc.]. The fleas were not identified, but since the rat-flea population of the area consists of *Xenopsylla cheopis*, Roths., and *X. astia*, Roths., in the proportion of 1 : 4, it is probable that the suspension of fleas used for injection into guineapigs comprised these species in similar proportions.

CASPARI (E.). **Kann die Bettwanze bakterielle Infektionserreger verbreiten?** [Can the Bed-bug spread Bacterial Infections?]—*Tib. Fakültesi Mecm. Istanbul* **1** no. 7 pp. 972–983, 1939. (Abstr. in *Bull. Inst. Pasteur* **38** no. 8 p. 379. Paris, 1940.)

Paratyphoid bacilli ingested with blood by bed-bugs [*Cimex*] fed on infected mice remain alive and virulent in the stomach for 2–3 weeks,

but they cannot usually be transmitted by biting to healthy animals. They may, however, be disseminated by crushing the bugs or by means of their excreta [*cf.* *R.A.E.*, B **27** 149].

NIESCHULZ (O.). **Ueber die mechanische Uebertragung von** *Trypanosoma congolense* **durch** *Aedes aegypti*. [The mechanical Transmission of *T. congolense* by *A. aegypti*.]—*Arch. Schiffs- u. Tropenhyg.* **44** pt. 1 pp. 30–33, 1 fig. Leipzig, 1940. **Versuche über die unmittelbare Uebertragung von** *Trypanosoma congolense* **durch** *Stomoxys calcitrans*. [Experiments on the direct Transmission of *T. congolense* by *S. calcitrans*.]—*T.c.* pt. 3 pp. 120–124.

In districts in which *Trypanosoma congolense* occurs in the absence of *Glossina*, mechanical transmission by other blood-sucking insects is assumed to take place. The practical importance of such transmission has not yet been defined, since few experimental investigations on it have been made.

In the first of these papers are recorded 34 experiments carried out at Utrecht in 1938–39 at a temperature of 24–30°C. [75·2–86°F.] and 60–70 per cent. relative humidity in which 1,000 females of *Aëdes aegypti*, L., were allowed partly to engorge on guineapigs infected by *T. congolense* and were then transferred to healthy guineapigs. Those that failed to complete the meal were not included in the results. The transfer was effected as quickly as possible, the interruption in feeding averaging 16–17 seconds and not exceeding 1 minute. In two experiments, in each of which 50 mosquitos were used, positive results were obtained, the incubation periods lasting 9 or 10 and 12 or 13 days. The trypanosomes remained alive in the digestive tract of *A. aegypti* for at least 24 hours, but lost their capacity for infection in about 3 hours.

In the second paper are recorded similar experiments with 1,150 examples of *Stomoxys calcitrans*, L., and the same strain of *T. congolense*. This strain was very virulent to guineapigs. The first 35 tests, in which feeding was interrupted for an average of 8·5 seconds, all gave negative results, but in the other 17, in which the interval averaged 4·5 seconds and did not exceed 1 minute, positive results were obtained in 3, in which the interval averaged 5·2 seconds. The trypanosomes remained alive in the digestive tract of the flies for at least 24 hours, but lost their capacity for infection in 5 hours.

NIESCHULZ (O.). **Over de mechanische overbrenging van ziekten door bloedzuigende insecten.** [The mechanical Transmission of Diseases by Blood-sucking Insects.]—*Tijdschr. Diergeneesk.* **66** pt. 12 repr. 4 pp. The Hague, 1939. [Recd. 1940.]

The author reviews published experimental work on the mechanical transmission by blood-sucking insects of surra, anthrax, haemorrhagic septicaemia of buffaloes, and fowl-pox, and briefly discusses the suitability for such transmission of the various causal agents. He concludes that its importance has been established only in the case of surra, which is not transmitted in any other way. No conclusion can as yet be formed with respect to diseases that are also transmitted by other means, but it is considered that the importance of mechanical transmission should not be overestimated in these cases, although many insects have shown a high experimental transmission capacity.

Headlee (T. J.). **The New Jersey Tick Problem.**—*Circ. N. J. agric. Exp. Sta.* no. 395, 12 pp., 4 figs., 11 refs. New Brunswick, N.J., 1940.

The five ticks known to occur in New Jersey are *Amblyomma americanum*, L., *Ixodes hexagonus* var. *cookei*, Pack., *Rhipicephalus sanguineus*, Latr., *Haemaphysalis leporis-palustris*, Pack., and *Dermacentor variabilis*, Say. The first two are rarely found and are unimportant. Notes are given from the literature on the distribution and hosts of the other three. *R. sanguineus* appears to be a tropical or sub-tropical species that is spreading to the temperate zones through the movement of dogs, the principal hosts, and is becoming an important household pest. If dogs that have access to the house are not kept free of ticks by dusting with a mixture of derris root (200–300 mesh) and talc (3 : 1) or by some other means, eggs may be laid on the floors in the cracks around the skirting boards and elsewhere, and elimination of the young ticks may be extremely difficult. *H. leporis-palustris* transmits tularaemia and Rocky mountain spotted fever among small rodents, and *D. variabilis* transmits them to man. Cleared land covered with clipped grasses is unfavourable to the propagation of *D. variabilis*, the early stages of which are passed on small rodents. For houses in woodland, the use of fly-sprays in crevices and furniture is recommended. Dogs found to be infested should be dusted with the derris-talc mixture, and persons going into tick-infested territory should be inspected on return and any ticks on them removed, preferably with forceps.

Pierpoint (R. L.). **Terpene Ethers in Pyrethrum and Rotenone Fly Sprays.**—*Bull. Del. agric. Exp. Sta.* no. 217, 59 pp., 15 figs., 7 refs. Newark, Del., 1939. [Recd. 1940.]

Since pine oil increases (activates) the toxicity and repellence of pyrethrum and derris extracts used in sprays against flies on cattle [*R.A.E.*, B **24** 304], attempts were made to incorporate it in household sprays, but in most cases the concentrations necessary to give the desired activation produced an odour that could not satisfactorily be masked. A preliminary study of terpenes indicated that terpene ethers were the most promising class of compounds for enhancing the value of pyrethrum in fly-sprays without introducing the odour associated with pine oil, and that certain of them effected an activation superior to pine oil even at much smaller dilutions. As terpene ethers can be synthesised from terpenes obtained from turpentine, investigations, which are described in this bulletin, were undertaken to determine whether they could be used with pyrethrum or rotenone in the manufacture of insecticides of higher quality and lower cost than those hitherto available. Descriptions are given of the materials used, which comprised a petroleum base oil, a pyrethrum extract in the base oil, a rotenone extract in safrol (a substance used to keep the rotenone in solution in the oil base), and six terpene ethers. The toxicity tests were carried out on reared house-flies (*Musca domestica*, L.) in a slightly modified Peet-Grady chamber. The method followed was essentially that described by Peet & Grady [**16** 255], the only considerable change being the use on the floor of the spray chamber of paper, which was changed after every test. The results, with the

exception of the preliminary ones, were evaluated according to the method suggested for use with the Official Control Insecticide [*cf.* **27** 23]. Preliminary tests on the relative toxicity of various synthetic terpene ethers in pyrethrum sprays were carried out in 1936. Further tests with the two most toxic in the base oil clearly indicated that ethylene glycol ether of pinene (D.H.S. Activator) was the more effective. The fact that the mortality increased as more of this product was added indicated that it was relatively toxic in itself. Its activating effect became apparent in later experiments, when the results showed that the mortality produced by it in combination with pyrethrum was greater than the sum of the mortalities produced by each applied separately.

The greater part of the bulletin (pp. 20–59) deals with the results obtained when increasing amounts of the D.H.S. Activator were added either to the pyrethrum or the rotenone and safrol sprays, and the following is largely taken from the author's summary of them. A marked increase in the insecticidal action of solutions containing 50, 75, 100, 125 and 150 mg. pyrethrins, respectively, per 100 cc. in the petroleum oil base was obtained by the addition to each of 2·5, 5, 7·5 and 10 per cent. (by volume) D.H.S. Activator. The mortality was increased by approximately 10 per cent. for each 2·5 per cent. of the activator added. The combined sprays showed the rapid toxic action of both ingredients, there being no significant mortality after 24 hours. The "knockdown" time with the lower concentrations of pyrethrum was reduced in proportion to the amount of activator; this did not hold good for the higher concentrations of pyrethrum. The pyrethrum spray at a concentration of 100 mg. and the same spray containing the same range of additions of the activator were stored in air-tight tins at room temperatures ranging from 70 to 80°F. for 22 months without any loss in toxicity or reduction in activation effect. The combinations disintegrated more rapidly than pyrethrum alone when exposed to light (not sunlight) in flint glass bottles under the same conditions. No loss in toxicity or reduction in the activation effect was recorded after their exposure to heat (a constant temperature of 100–105°F.) in air-tight tins for 8½ months. After this time a loss of toxicity did occur in the samples containing 5, 7·5 and 10 per cent. of the activator, but not in the other two samples. The addition of the activator did not retard loss in colour or precipitation (definite indications of loss of toxicity in pyrethrum fly-sprays) when such sprays were exposed to sunlight, light or constant high temperatures.

The insecticidal action of sprays containing 50 and 100 mg. rotenone per 100 cc. plus 7·5 per cent. safrol in the petroleum oil base was also increased by the addition of the same proportions of the activator, but only at the rate of about 5 per cent. for each 2·5 per cent. The mortality at 24 hours was increased without any significant reduction in the 24–48 hour mortality characteristic of rotenone sprays; and the rapidity of the "knockdown" was increased with the amount of the activator. The results of storage at room temperature and exposure to constant heat were similar to those with pyrethrum. The loss in toxicity on exposure to sunlight and light in flint glass bottles was correlated with colour changes and precipitation, which are not, however, a certain indication of reduction in efficiency. Although disintegration apparently takes place more rapidly than in the case of the rotenone and safrol alone, the activator maintained the combined sprays at a relatively high toxic level. It is concluded that ethylene

glycol ether of pinene is an effective activator for both pyrethrum and rotenone and can be safely and economically included in commercial fly-sprays.

Chow (C. Y.). **The Common Blue-bottle Fly,** *Chrysomyia megacephala*, **as a Carrier of Pathogenic Bacteria in Peiping, China.**—*Chin. med. J.* **57** no. 2 pp. 145–153, 8 refs. Peiping, 1940.

Observations during recent years suggested that the seasonal distribution of flies in Peiping is somewhat similar to that in Tsinan [*R.A.E.*, B **26** 145]. In view of the probability that *Chrysomyia megacephala*, F., is a carrier of the bacteria of faecal-borne diseases, on account of its habit of breeding almost entirely in liquid human excrement and feeding on sweets, fruit, etc. [*cf.* **14** 181 ; **26** 145 ; **28** 157], experiments were carried out in August and September 1939 to determine the kinds of bacteria it carried in nature and to what extent they survived on it. A total of 650 adults of *C. megacephala* was taken from open public latrines, a garbage container, and fruit shops and a vegetable market. The method by which they were examined for bacteria carried both externally and internally is described. All the flies from latrines and garbage containers and 80 per cent. of those from fruits and vegetables carried *Bacillus coli* externally, and all those from latrines and 82 and 80 per cent., respectively, of those from garbage containers and fruits and vegetables carried it internally. In addition, 8 per cent. of the flies from latrines carried *Bacillus dysenteriae* (of the mannite-fermenting group) internally. No other flies carried *B. dysenteriae* internally or externally, and none carried typhoid bacilli or bacteria of the paratyphoid group. To determine whether the low rate of infection with *B. dysenteriae* and the absence of infection with *B. typhosus* was due to lack of bacteria in the faeces or to loss of infection before the flies were examined, experiments were carried out with laboratory-bred flies and pure cultures of *B. dysenteriae* and *B. typhosus* to determine how long the organisms could survive on or in the body of the flies. Dysentery bacilli of the Shiga and mannite-fermenting groups and *B. typhosus* lived on the surface of the body of the fly for 4, 4 and 2 days, and in the intestine for 5, 4 and 5 days, respectively. Although the number of flies used was small, the results clearly indicate that once the fly is infected, *B. dysenteriae* and *B. typhosus* can live long enough to be transferred to food-stuffs on which the fly feeds.

[Balkashina (E. I.).] **Балкашина (Е. И.). La faune de Culicinae de la région du Kazakhstan méridional.** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 19–38, 3 figs., 1 diagr., 1 graph, 7 refs. Moscow, 1939. (With a Summary in French.) [Recd. 1940.]

A detailed account, based on collections in 1935–37, is given of the local distribution of mosquitos in the Province of Southern Kazakstan, where Anophelines and malaria are associated with rivers and marshes connected with the Suir-Dar'ya and with lakes and rice-fields. On the basis of topography and climate, the Province is divided into three regions, *viz.*, the foot-hills of the mountains, the southern subtropical desert areas, which are of the Mediterranean type, and the northern deserts, which have the character of the deserts of Central Asia. The Anophelines found were *Anopheles maculipennis*, Mg.,

A. claviger, Mg. (*bifurcatus*, auct.), *A. hyrcanus*, Pall., *A. pulcherrimus*, Theo., and *A. superpictus*, Grassi.

A. maculipennis occurred everywhere, but was most abundant in the northern desert districts and foot-hills. The larvae were found in ponds, slightly brackish lakes, flooded meadows, swamps and springs, and occasionally in barrels. The adults entered hibernation quarters in mid-November and began to abandon them in the second half of February. *A. claviger* was rare in the desert districts and abundant in the foot-hills. The larvae were found throughout the year in springs and places flooded by mountain rivers, sometimes in disused wells, and rarely in water reservoirs of the irrigation system. The first adults of the year appeared at the end of February or beginning of March, and the last eggs were found at the end of October or on warm days in November in springs that did not freeze. *A. hyrcanus* was abundant in the deserts of both types and rare in the foot-hills; the larvae were found from mid-May to October, chiefly in accumulations of water of subsoil origin or connected with the irrigation system. *A. pulcherrimus* was absent in the north, but was very abundant in the southern desert area and also occurred in the adjoining foot-hills. The larvae were found in stagnant water of the irrigation system, lakes, ponds, rice-fields and places flooded by mountain rivers, and some were taken at an altitude of nearly 4,300 ft. The larvae of *A. superpictus* chiefly occurred in flooded meadows along rivers in the southern foot-hills; engorged females were common in animal quarters in winter.

[GELLER (É. R.).] **Геллер (Э. Р.). Sur la faune des culicidés du Kazakhstan.** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 39–49, 9 graphs. Moscow, 1939. (With a Summary in French.) [Recd. 1940.]

On the basis of personal observations in 1934–37 and collections by other workers, notes are given on the distribution, abundance and breeding places of 30 species of mosquitos in the Republic of Kazakstan. It occupies an area of over a million square miles and comprises the forest-steppe and steppe zones, the semi-deserts and deserts, and the foot-hills of the Altaĭ and the Tyan'shyan mountains, so that the climate varies greatly.

Of the Anophelines found, *Anopheles maculipennis*, Mg., was the most common and widely distributed, occurring up to an altitude of 3,900 ft. The number of generations a year varied from 2 in the Altaĭ foot-hills to 9 in the sandy desert in the south. Race *messeae*, Flni., predominated, but a form belonging to the group of *atroparvus*, van Thiel, was found in some localities. Race *sacharovi*, Favr, occurred in the south, chiefly near brackish water on the sandy deserts and loess plains. *A. hyrcanus*, Pall., and *A. pseudopictus*, Grassi, were rather less widely distributed, being usually found in flooded areas near rivers overgrown with reeds. They attacked man and animals in the open, chiefly in the evening and at night, but their importance in the spread of malaria was negligible. *A. pulcherrimus*, Theo., which is an important vector of malaria in many districts, and *A. superpictus*, Grassi, were common in the desert area in the south; *A. claviger*, Mg. (*bifurcatus*, auct.) was abundant in the south-eastern part at the foot of the mountain range; and *A. algeriensis*, Theo., was found in the southern districts that have a Mediterranean climate.

[KALANDADZE (L. P.) & SAGATELOVA (I. S.). **Каландадзе (Л. П.) и Сагателова (И. С.). Observations sur les pontes de l'***Anopheles maculipennis maculipennis*. [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 50–55, 3 refs. Moscow, 1939. (With a Summary in French.) [Recd. 1940.]

Laboratory investigations on the oviposition of the typical race of *Anopheles maculipennis*, Mg., were carried out with females that had had their wings clipped to prevent them from flying. Contrary to observations by Detinova, they did not drink water before ovipositing [*cf. R.A.E.*, B **25** 142]; and, as a rule, they did not oviposit unless they had completed the digestion of blood. If they were ready to oviposit, they began to do so a few minutes after being placed on water, the average time required varying with the temperature of the water or air. Thus, when the temperature of the water was kept at 17–20°C. [62·6–68°F.], the average times were 6·5, 4·7 and 3·7 minutes at air temperatures of 22, 28·1 and 30°C. [71·6, 82·58 and 86°F.], respectively. When the temperature of the water was varied from 1 to 45°C. [33·8–113°F.] and the air temperature was 24–27°C. [75·2–80·6°F.], no mosquitos oviposited if the water temperature was below 5°C. [41°F.]; half did so if it was 10°C. [50°F.], and practically all if it was 15–30°C. [59–86°F.]. If it was higher, many females did not oviposit and all died in 4–14·5 minutes. The time required for oviposition to begin was 10 minutes when the water temperature was 5°C. and 1·2–2·8 minutes (the minimum) when it was 25°C. [77°F.].

Humidity is essential for the eggs, as those that were laid on dry soil or a leaf did not hatch if placed on water 1–5 minutes later. On the other hand, eggs that were laid on moist soil and were placed on water after periods of up to 72 hours all hatched. Air is also necessary, however, for if, as sometimes happened, the eggs were deposited below instead of on the surface of the water, they sank to the bottom, their milky colour changed to black as a result of the penetration of the water between the endo- and the exochorion, and, with very few exceptions, they did not hatch. Eggs deposited so that they were only partly submerged and the water penetrated only a part of the exochorion also turned black, but up to 33 per cent. hatched. When eggs deposited on the surface of water were immediately submerged in small open boxes covered with muslin, up to 80 per cent. turned black, but about half of these hatched. The remainder retained air under the exochorion and did not lose their milky colour, and practically all of them hatched.

[KESHISH'YAN (M. N.).] **Кешишьян (М. Н.). A Discovery of** *Anopheles barianensis* **James in Tadjikistan.** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 60–71, 6 figs., 5 refs. Moscow, 1939. (With a Summary in English.) [Recd. 1940.]

Larvae of *Anopheles barianensis*, James, an Indian Anopheline not hitherto recorded from the Russian Union, were found in August 1938 in water in tree holes at an altitude of nearly 4,300 ft. in a pass in the Hissar mountains in western Tadzhikistan. Adults were reared from them and the females repeatedly sucked blood, but there was no evidence of pairing and no eggs were obtained. Later, both adults and larvae were taken in tree holes in other passes in the Hissar mountains. Detailed descriptions are given of the adults of both

sexes, larvae and pupae, with notes on the characters distinguishing the adults and larvae from those of other species of *Anopheles* that breed in tree holes.

[Reĭngard (L. V.) & Goritzkaya (V. V.).] **Рейнгард (Л. В.) и Горицкая (В. В.). Contribution au problème de la distribution des sous-espèces de l'*A. maculipennis* Meig. dans la région de Dnjepropetrovsk.** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 72–76, 5 refs. Moscow, 1939. [Recd. 1940.]

Of 960 batches of eggs laid in captivity by females of *Anopheles maculipennis*, Mg., taken in 15 different districts in the region of Dniepropetrovsk in central Ukraine, 64·6 per cent. belonged to race *messeae*, Flni., and 21·1 per cent. to *atroparvus*, van Thiel, 8·6 per cent. were dark eggs, which the authors consider to represent a melanic form of *atroparvus* [*cf. R.A.E.*, B **26** 220], and only 5·7 per cent. belonged to race *maculipennis* (*typicus*). The local distribution and relative abundance of these races are shown in a table; *messeae* occurred everywhere and was the chief vector of malaria in many localities, while *atroparvus* was most numerous in the northern districts. Engorged females, including those of *messeae*, were taken in cow-sheds throughout the winter, and, in one locality, *messeae* was found hibernating in inhabited houses. Adults of the three races frequently occurred simultaneously in the same cow-shed, and in one instance the eggs were found together in the same breeding place. Some of the eggs examined closely resembled those of race *labranchiae*, Flni., which does not occur in the Ukraine [*cf.* **26** 240].

[Reznik (P. A.).] **Резник (П. А.). The Fauna and the Oecology of Mosquitoes of the Family Culicidae.** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 77–78. Moscow, 1939. [Recd. 1940.]

An annotated list is given of 13 species of mosquitos collected during 1934–37 in and near the town of Voroshilovsk, which is situated on the Stavropol plateau in northern Caucasus at an altitude of over 1,800 ft. The mosquitos are favoured by the presence of swamps, ponds and numerous springs fed by subsoil water. The two species of *Anopheles* found were *A. claviger*, Mg. (*bifurcatus*, auct.), which was rare, and *A. maculipennis*, Mg., which was common. Females of the latter hibernated chiefly in cellars of houses and began to abandon these quarters at the beginning of April; the larvae were found from 20th April to the end of September.

[Ovchinnikov (K. M.) & Tishchenko (O. D.).] **Овчинников (К. М.) и Тищенко (О. Д.). Effet des déversoirs sur les larves *Anopheles maculipennis*. (Résultats des expérimentations de 1937.)** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 79–86, 10 figs. Moscow, 1939. [Recd. 1940.]

Investigations on the effect of flowing water on larvae of *Anopheles maculipennis*, Mg. [*R.A.E.*, B **25** 269; *cf.* also **27** 173] were continued in the summer of 1937 in irrigation ditches on a farm in the Province of Donetz and in a laboratory in Kharkov in which model weirs were installed. In both series of experiments, known numbers of larvae were placed above weirs of different types, which are described, and

caught below them in muslin bags stretched on frames; the discharge of the water was regulated by means of shields. After the water had been discharged, the larvae in the bags were counted and the number dead was expressed as a percentage of the initial number. The results, which are tabulated, showed that under field conditions, up to 70 per cent. (with a mean of 50) of the larvae of *A. maculipennis* in irrigation ditches, canals or canalised rivers may be destroyed by the force of the current if weirs of the type of waterfalls [*cf.* **25** 270] are installed. More larvae were killed if the number of falls over which they passed was increased, but the percentage mortality was not affected by discharging a greater volume of water or by increasing the height of the waterfall from about 1 to 3–4 ft. The most effective type of weir, therefore, would be one with several shallow and wide steps. It was also observed that an increase in the rate of mortality occurs if the exposure of the larvae to rough water is prolonged; it would be advisable, therefore, to produce artificial waves on the surface of the water by special flushing, which would be feasible in canals and canalised rivers that have sluices.

The physiological condition of the larvae (their movements and reaction to disturbance) immediately after they had passed through the weirs is discussed, and it is concluded that they die chiefly from injuries caused by the force of falling water.

[Dzhangirov (K. G.).] **Джангиров (К. Г.). Utilisation de l'infusion du tabac dans la lutte contre le moustique.** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 93–94. Moscow, 1939. [Recd. 1940.]

Tobacco dust is often used for fumigating against adult mosquitos in day-time shelters and hibernation quarters in the tobacco-growing district of Slavyansk in northern Caucasus, but the fumigation is unsatisfactory in many of the buildings owing to cracks in walls and other defects. Experiments on the possibility of using the tobacco as a spray against mosquitos in cellars were therefore carried out in December 1938. The spray was prepared by allowing 5 lb. tobacco dust to steep in 1 gal. cold water for 1–2 days and then straining the infusion, which contained about 0·1 per cent. nicotine. Examination of the cellars 24 hours after spraying showed that 88·7–97 per cent. of the mosquitos were killed when the infusion was used alone, and 100 per cent. when 0·5 per cent. soft soap was added to it just before it was applied. The mixture did not remain in good condition for more than ten hours.

[Trofimov (G. K.).] **Трофимов (Г. К.). Sur l'écologie des larves de l'*Anopheles pulcherrimus* Theo. dans la zone des steppes de Schirva affeurant** [*sic*] **de la rivière Koura (Transkaukasie).** [*In Russian.*]—*Med. Parasitol.* **8** no. 5 pp. 94–96, 2 figs. Moscow, 1939. [Recd. 1940.]

A description is given of a group of swamps situated along the left bank of the river Kura in the south-western part of the Shirvan steppe in Azerbaijan, which offer favourable conditions for the breeding of *Anopheles pulcherrimus*, Theo. The swamps cover an area of about 250 acres in spring, but become less extensive during the summer owing to evaporation; towards autumn some of them dry up completely. Water remains throughout the summer in shallow depressions

that are exposed to the sun and have a clayey bottom ; the water is turbid and clumps of rushes grow in it. In August–September, the larvae of *A. pulcherrimus* were very abundant in these depressions, and a few larvae of *A. maculipennis*, Mg., and *A. hyrcanus*, Pall., were also found in them.

WILCOXON (Frank), HARTZELL (A.) & WILCOXON (Fredericka). **Insecticidal Properties of Extract of Male Fern** (*Aspidium filix-mas* [**L.**] **Sw.**).—*Contr. Boyce Thompson Inst.* **11** no. 1 pp. 1–4, 1 fig., 14 refs. Menasha, Wis., 1939. [Recd. 1940.]

An account is given of the method by which crude filicin and the " Filixsäure " of R. Boehm and other workers were prepared from a commercial extract of the rhizome of male fern (*Aspidium filix-mas*) and of laboratory tests on the toxicity of crude filicin to *Aphis rumicis*, L. [*cf. R.A.E.*, A **28** 515]. In tests on the larvae of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) carried out by a method described in a paper already noticed [B **21** 176], an acetone solution of " Filixsäure " proved four times as toxic as one of crude filicin, of which " Filixsäure " is therefore considered to be one of the important toxic principles. Tests on house-flies (*Musca domestica*, L.) were made with a spray containing 0·2 per cent. crude filicin and 0·05 per cent. pyrethrins. The tests were made according to the Peet-Grady method, and the percentage mortality given by the spray was 52·0, as compared with 53·1 by the official test insecticide [*cf.* **27** 23].

KINGSBURY (A. N.). **Annual Report of the Institute for Medical Research (F.M.S.) for the Year 1938.**—Med. 8vo, 179 pp. Kuala Lumpur, 1939. [Recd. 1940.]

The report of the Division of Entomology (pp. 64–79), by E. P. Hodgkin, includes an account of investigations on the transmission of *Filaria* (*Microfilaria*) *malayi*, which were continued throughout the year [*cf. R.A.E.*, B **27** 11]. With regard to the control of *Mansonia longipalpis*, Wulp, which is apparently the most important vector in Malaya and has recently been found to breed in swamps [*cf.* **28** 5, 6], it is pointed out that, where the swamps are not too extensive, drainage undertaken for the improvement of land (as in the construction of rice-fields) should prove beneficial. Dissections of mosquitos that had been fed on carriers of the microfilariae confirmed the view that all the five local species of the subgenus *Mansonioides*, except *Mansonia indiana*, Edw., are efficient experimental vectors [*cf.* **27** 11], though the length of time that elapsed before the appearance of mature larvae varied with the different species. Neither *Anopheles barbirostris*, Wulp, the vector in the Celebes, nor *A. hyrcanus* var. *sinensis*, Wied., the vector in China, proved to be efficient hosts, since only 2 out of 76 of the former and 1 out of 90 of the latter became infected. On the other hand, 34 out of 148 examples of *A. hyrcanus* var. *nigerrimus*, Giles, dissected 7 or more days after an infective blood-meal, contained larvae of *F. malayi* in different stages of development. Dissections were also made of a considerable number of mosquitos caught in human-bait traps in villages in endemic areas on the Perak and Pahang rivers near the limit of tidal influence. Larvae resembling *F. malayi* were found in *M. indiana*, *M. longipalpis* and *M. uniformis*, Theo., which were the only species taken in large numbers. It is pointed out that although

it is certain that these larvae were not those of *F.* (*Dirofilaria*) *immitis*, which was also found in these three species of *Mansonia* and in *A. barbirostris*, and they were unlikely to have been those of *F.* (*Wuchereria*) *bancrofti*, they might not have been of human origin [*cf.* **28** 5]. In traps in villages on or near the Pahang river, *M. uniformis* and *M. longipalpis* were the most prevalent species. There seems to be little doubt that *M. longipalpis* is the principal vector of *F. malayi* in areas where its transmission has been studied, though other species of *Mansonia* may play a part when they are abundant.

Large numbers of mosquitos, chiefly *M. longipalpis* and *M. uniformis*, fed on monkeys (*Macacus irus*) infected with the parasite resembling *F. malayi* [**28** 5] became infected as readily as with the latter. Neither the immature or mature larvae could be distinguished from *F. malayi*, and development in the mosquitos appeared to be identical. Numerous mosquitos infected with *F. malayi* were fed on monkeys, and mature larvae of *F. malayi* dissected from mosquitos were placed on the scarified skin of monkeys, but the blood of the monkeys was still negative 6–12 months later.

Work on the trapping and dissection of mosquitos on a malarious estate was continued and confirmed previous results [*cf.* **27** 10]. Investigations in villages on the Selangor coast were also continued. Trapping was recommenced in October 1938 in the village in which it had been suspended in the previous year [*loc. cit.*]. In the second village the trap was again moved, this time to a spot where no bund prevented the ingress of salt water. Both *A. baezai*, Gater, and *A. sundaicus*, Rdnw., were found breeding in cultivated land nearby, where most of the pools and many of the drains are flooded with brackish water at least twice every month. The former was the commonest species in the trap collections; the latter was taken throughout the year, but not in large numbers. Most of the mosquitos caught were dissected, but the only one infected with malaria parasites was a female of *A. baezai* that showed apparently degenerate sporozoites in the salivary glands. During previous years, large numbers of Anophelines taken in this village, including nearly 4,000 examples of *A. sundaicus*, were dissected, but no instance of gland infection was observed. A comparison of catches made in the trap and in a neighbouring cattle shed showed that *A. baezai* and *A. barbirostris* were relatively more numerous in the former, and *A. vagus*, Dön., and *A. kochi*, Dön., in the latter. It has been observed that the two exclusively brackish-water species, *A. baezai* and *A. sundaicus*, seem to prefer to breed in different places. The only obvious difference is that the former generally favours those that are more shaded and the latter those that are exposed to full sunlight. Analyses of 50 samples from breeding places of each showed no differences in the chemical composition of the water. *A. umbrosus*, Theo., continued to be the only species prevalent in the third village; 2 out of 270 dissected from among those caught in the trap and 2 out of 49 caught by hand contained sporozoites in the salivary glands.

The review of the results of tests with mixtures of oils against Anopheline larvae is similar to one already noticed [*cf.* **28** 84]. Lists are given of the female Anophelines caught in traps in Kuala Lumpur and in a locality in Lower Perak and collected from the Singapore and Penang mail trains, showing the numbers dissected; 6 females of *A. maculatus*, Theo., from Kuala Lumpur showed malaria infection, 3 in the glands, and 1 female of *A. sundaicus* from the other locality

showed sporozoites in the glands. This is the first record of infection in *A. sundaicus* among more than 4,000 specimens dissected during the last five years. A list is also given of the Anophelines caught in the trap in the first village mentioned, showing the number dissected and also the number of breeding places noted for each species and the number of larvae collected. Two females of *A. barbirostris* were infected, one in the salivary glands.

In the course of his report on the work of the Division of Malaria Research (pp. 96–114), J. W. Field gives an account of what was planned to be a year's trial of prophylactic plasmoquine begun in March 1938 on an estate on which malaria is hyperendemic and due mainly to *Plasmodium vivax*. In the surrounding jungle and the irregular jungle fringe of the estate, there is extensive and uncontrolled breeding of *A. umbrosus* and *A. novumbrosus*, Strickl. A comparison of the infection rates in these two species in 1938 and in 1937, when atebrin and quinine were the drugs used, indicated that mosquito infections were not eliminated by the plasmoquine, and the fact of transmission was proved by observations on the time and incidence of freshly contracted malaria in uninfected newcomers and on the time of the first attack in infants born on the estate. Gametocytes of *P. vivax* were constantly found in persons who had acute attacks of malaria while they were receiving the regular treatment with plasmoquine. When reared examples of the two species of mosquitos were fed on some of these gametocyte carriers, no infection of the salivary glands was obtained, but two examples of *A. umbrosus* had gut infections, and one showed numerous sporozoites round a ruptured oöcyst. It is concluded that plasmoquine prophylaxis as carried out in this experiment was a failure for reasons that have not yet been ascertained.

In his report on the work of the Division of Pathology (pp. 114–140), R. Lewthwaite states that he and S. R. Savoor continued their investigations of the viruses of typhus-like fevers. In the previous year a murine virus, X19 in type, was isolated from rats trapped in an area where tsutsugamushi disease was endemic, and, since a study in laboratory animals had revealed certain anomalous features, attempts were made to transmit it from guineapig to guineapig by means of *Xenopsylla cheopis*, Roths. The findings suggested that a strain of XK type had been derived from the parent strain of X19 type. Tests completed early in 1938 revealed complete cross-immunity with two XK strains of tsutsugamushi disease and complete absence of cross-immunity with the parent strain (designated rat-strain E). The phenomenon was sufficiently remarkable to warrant repetition, since it seemed just possible that some vector capable of feeding on the guineapigs might have been present in the sand covering the bottom of the tank in which they were kept. In the repeated experiment, steps were taken to remove this possibility. Examples of *X. cheopis* were kept for 5 days with guineapigs infected with the parent strain E. Three fleas withdrawn on the 10th day and 1 on the 19th day and injected into guineapigs produced symptoms typical of the X19 strain. The infected guineapigs were replaced by normal ones on the 5th day, and subinoculations from these animals produced, at the third passage, symptoms due to an XK type. No difficulty was experienced in maintaining this strain (called EK2) in guineapigs through 17 generations without loss of virulence. Cross-immunity tests gave results similar to those of the strain isolated in the same way in the previous year. Further investigations are being made.

Experiments with two introduced strains of Sumatran mite-fever and Malayan strains of tsutsugamushi disease [*cf.* **26** 20] in laboratory animals indicated, contrary to the views of Dutch authors [*cf.* **23** 107], that the slight differences observed are insufficient to justify the separation of these diseases.

ROUBAUD (E.). **Études sur l'éradication des puces.**—*Bull. Soc. Path. exot.* **33** no. 3 pp. 153–156, 9 refs. Paris, 1940.

In further experiments on the control of fleas with insecticidal dusts [*cf. R.A.E.*, B **28** 148], tests were made of the effect of sodium fluosilicate, boric acid and borax on larvae, and rotenone dusts on adults and larvae, of *Ctenocephalides canis*, Curt. For the treatment of dwelling houses, sheds and business premises against the larvae, the only substance recommended in addition to sodium fluoride [*loc. cit.*] is boric acid mixed with powdered slaked lime or talc in the ratio of 1 : 3 by volume. Conditions of use and cost are similar to those of the fluoride. Very effective control of the adults on animals was obtained with a dust composed of 2 parts by weight of an extract containing 72 per cent. pure rotenone, 3 parts calcium carbonate and 3 parts talc. Such a dust is too expensive for use as a larvicide, and crude derris dust was not effective.

RAYNAL (J.). **Le typhus murin à Chang-Haï.**—*Bull. Soc. Path. exot.* **33** no. 3 pp. 168–175, 13 refs. Paris, 1940.

This further account of the outbreak of typhus that occurred in Shanghai in 1938 [*R.A.E.*, B **28** 13] includes additional data on the disease in rats. All the rats taken were *Mus rattus*. Fleas were numerous on them in spring, practically absent in summer and more numerous again by October. The fleas found from April to June 1939 comprised *Leptopsylla segnis*, Schönh. (*musculi*, Dug.) and *Ceratophyllus fasciatus*, Bosc, in the proportion of 44 to 1, *Xenopsylla cheopis*, Roths., being absent. Six experiments on the isolation of the typhus virus were made with rats and two with *L. segnis*. One of the experiments with *L. segnis* gave a negative result, and the other was incomplete and the result in doubt when this paper was written, but the virus of murine typhus was isolated in two of the experiments with rats. Two strains of virus were isolated from man, one almost identical with that of pure murine typhus and the other intermediate between this and louse-borne typhus. The latter is thought to be the result of the passage of murine typhus through man and lice [*Pediculus humanus*, L.]. It is concluded that murine typhus occasionally passes from rat to man, probably either through the agency of fleas or through the excreta of the rats, and that it may sometimes become adapted to the cycle man-louse-man.

TOUMANOFF (C.) & CANET (J.). **Quelques faits nouveaux au sujet de la transmission du paludisme dans la région des terres-rouges du Nord-Cochinchine.**—*Bull. Soc. Path. exot.* **33** no. 3 pp. 188–194. Paris, 1940.

Many females of *Anopheles hyrcanus* var. *sinensis*, Wied., taken in the Red Soil region of Cochin China and southern Annam in places where cattle are numerous have been dissected, but none has been

found infected with malaria parasites. In 1939, however, one individual found in the Red Soil region of northern Cochin China in a locality practically devoid of cattle had numerous oöcysts on the stomach wall, two of which were full of sporozoites. It was taken in October during the rainy season, when *A. minimus*, Theo., and *A. jeyporiensis*, James, the chief vectors, are scarce [*cf. R.A.E.*, B **26** 99]. It is thought, therefore, that *A. h. sinensis* may be a vector in districts of the Red Soil region where cattle are scarce and may be responsible for epidemics in the rainy season, and it is considered that the usual measures taken against *A. minimus* should be supplemented by animal deviation of *A. h. sinensis* [*cf.* **26** 70] through the keeping of well-stabled cattle.

MATHIS (M.). **Biologie d'une souche de** *Culex pipiens autogenicus* **Roubaud 1933, au cours d'un élevage de vingt générations en série.** —*Bull. Soc. Path. exot.* **33** no. 3 pp. 201–207, 4 refs. Paris, 1940.

Rearing experiments on the autogenous urban strain of *Culex pipiens* var. *molestus*, Forsk. (*autogenicus*, Roub.) [*cf. R.A.E.*, B **21** 266] were begun with larvae and pupae taken in Paris in June 1937 from a tank of polluted water [*cf.* **21** 62] in a stable in which rabbits, guineapigs and fowls were kept. A strain started from a single egg-mass was bred without food of any kind in the adult stage through 20 generations. Of females that had emerged from pupae collected in June 1937, and of which some had paired and oviposited without feeding, only a few would feed on birds and none on man. In September 1938, females of the 19th autogenous generation to which sweetened water had been given after oviposition to prevent dehydration readily attacked man, and, in other similar experiments, birds and guineapigs were also attacked. The durations of the egg and pupal stages were constant throughout the 20 generations, but that of the larval stage varied according to the amount of food available. The percentage of females bred from larvae taken in nature that could oviposit autogenically was relatively small, but 78·2 per cent. of the aggregate number of females in the F_{11}, F_{12}, F_{14} and F_{16} generations did so, and autogenous reproduction by almost all females was obtained in later generations by supplying maximum nourishment for the larvae. Likewise, in optimum conditions with abundant larval food, the average number of eggs per female was much higher than that produced by females obtained from larvae taken in nature.

GIRARD (G.). **Foyers persistants de peste murine à Tananarive.**—*Bull. Soc. Path. exot.* **33** no. 3 pp. 209–211, 4 refs. Paris, 1940.

So little is known of the incidence of plague in rats in Madagascar that it has been doubted whether they are of importance as a reservoir of the disease there, particularly as it has been found that *Xenopsylla cheopis*, Roths., occurs not only on rats, but also in the dust in dwellings [*cf. R.A.E.*, B **26** 52, etc.], where it is able to maintain its infectivity. The author has shown, however, that plague may occur in rats without being evident, because of the presence of a bacteriophage in them [**23** 297]. In this paper, he cites two instances of persistent but very localised foci of rat plague, in which the disease becomes apparent at intervals of years. In one case, mortality among rats on a rural estate was high in 1927, 1932, 1934 and 1939 and was accompanied by single

deaths among the human population in 1927 and 1932. From premises in which dead or ailing rats had been found, 66 individuals of *X. cheopis*, none containing blood, were taken, and the presence of plague infection in them was demonstrated. In another case, single deaths occurred among the human population in a school in 1925 and 1939, and mortality was reported among rats. Fleas taken in dust on the premises consisted chiefly of *X. cheopis*, some of which were still full of blood, and the presence of infection was demonstrated in these also. Even in Tananarive, where steps are taken to exterminate rats and fleas from notified foci, it has not been found possible to destroy them. The destruction of fleas in buildings of which the floors are composed of beaten earth and the roofs of thatch is virtually impossible, particularly as the only species of rat present, *Mus* (*Rattus*) *rattus*, is a better climber than burrower. Vaccination is, therefore, advised to protect the human population from infection.

DAVIS (G. E.) & WALKER (M. E.). *Ornithodorus hermsi*: **Feeding and Molting Habits in Relation to the Acquisition and Transmission of Relapsing Fever Spirochetes.**—*Publ. Hlth Rep.* **55** no. 12 pp. 492–504, 3 figs. Washington, D.C., 1940.

It was observed in 1937 that the periods between the moults of *Ornithodorus hermsi*, Wheeler, are frequently lengthened in the winter months, and that the ticks may engorge more than once in these prolonged instars. Two investigations were begun in June 1938, one in Montana and one in Wyoming, on repeated feeding between moults and the ability of the ticks to transmit relapsing-fever spirochaetes during such periods. Of 20 ticks that reached the adult stage in the first experiment, all had engorged in the larval stage on a white rat infected with a *hermsi* strain of spirochaetes, and 16 in the first nymphal instar also. In the second experiment, 65 ticks survived to the adult stage. Of these, 27 received similar infecting feeds as larvae and first-instar nymphs, 11 as first- and second-instar nymphs and 26 at the second feeding in the second nymphal instar. One was not given an infecting feed. Multiple feeding took place between October and January in one of the nymphal instars (usually the second or third) in 75 of the 85 ticks. Of the 58 ticks that received their infecting meal or meals before the stage in which multiple feeding occurred, 38 later transmitted spirochaetes; 19 transmitted them during the multiple feeding period. Of the 26 ticks that received their infecting blood-meal during the multiple feeding period, 6 subsequently transmitted spirochaetes, 1 of them at the next feed in the same instar.

PHILIP (C. B.) & DAVIS (G. E.). **Relapsing Fever: Data implicating** *Ornithodorus hermsi* **as a Vector in northern Idaho.**—*Publ. Hlth Rep.* **55** no. 12 pp. 504–507, 4 refs. Washington, D.C., 1940.

In August 1938, two persons out of a group of six staying in a summer cabin on a mountain in north-western Idaho developed relapsing fever, spirochaetes being found in their blood, and two others had illnesses characteristic of the disease. At least two other persons who visited the same premises in previous years had illnesses of which the histories suggest relapsing fever. The only animals seen in the building were occasional mice (*Microtus*). A few ticks, later identified as *Ornithodorus hermsi*, Wheeler, were recovered from the

cabin in 1931. This was the first record of this tick outside California ; it is now known to be a vector of relapsing fever in both California and Idaho [*R.A.E.*, B **28** 99, etc.]. Ticks were taken in the cabin on a few occasions in subsequent years. Spirochaetes were found in the blood of a rat into which had been injected blood taken from one of the patients proved to be suffering from relapsing fever, and, after passage through other rats, were successfully transferred by the feeding of third-instar nymphs of *O. hermsi* that had fed on an infected rat in the preceding stage. The ticks were from previously non-infected stock from California.

HOBMAIER (A.) & HOBMAIER (M.). **On the Life-cycle of** *Linguatula rhinaria*.—*Amer. J. trop. Med.* **20** no. 2 pp. 199–210, 12 refs. Baltimore, Md, 1940.

Linguatula serrata, Fröhl. (*rhinaria*, Pilger) is of interest not only as a cosmopolitan parasite of livestock, but also as a facultative parasite of man in both the adult and nymphal stages. Work on the life-history of this mite is reviewed from the literature, and an account is given of studies of certain phases of the life-cycle begun with nymphs taken from brown rats (*Mus norvegicus*) found naturally infected in California between May 1934 and May 1935. Previous workers have shown that dogs can be infected if nymphs are introduced into the nose, but not by sniffing infected food. Infection was acquired by ingesting nymphs, and it was generally assumed, though not proved, that they could migrate actively from the stomach to the pharynx.

Of four dogs that received nymphs in meat, two, killed 3 days and 4 months later, respectively, were free from parasites. The third, which vomited 1 and 2 hours after the administration of the nymphs and was killed ½ hour later, showed no nymphs in the oesophagus or stomach, but 3 in the nasal cavities, and 4 were found in the vomit. The fourth dog vomited an hour after feeding and was killed 4 months later, when 5 adults were found in the nasal cavities. The vomit was fed to a fifth dog from which, when it was killed and examined 2½ hours later, 2 nymphs were recovered in the nasal cavities, but none in the oesophagus or stomach. Nymphs were not found in the internal organs or faeces of any of the dogs.

It has been assumed, from post-mortem examinations of intermediate hosts (rodents, cattle, etc.) recorded in the literature, that the nymphs leave the cysts during the 7th month, wander in the body of the host, causing lesions of various kinds that may be fatal, and are liberated from the respiratory tract or with faeces. In the authors' experiments, however, no free nymphs, haemorrhage or lesions were detected in guineapigs, rats or white mice killed during the 7th or 18th month after they were infected and dissected immediately, but many nymphs freed themselves spontaneously, and haemorrhage developed, if autopsy was delayed. Ecdysis could be observed under the dissecting microscope. It is concluded that the nymphs do not leave the cysts until the intermediate host has died. Longevity of nymphs could not be determined. Nymphs were found alive in guineapigs after 2½ years, but most of them required an unusually long time to free themselves and many failed to do so on account of the thickening of the wall of the capsule. It appears that the position of the parasite and the nutritional condition, health, species and age of the host influence the longevity of the nymphs. It is well known that nymphs may be

well developed in children, whereas they are usually calcified in adults. At 18°C. [64·4°F.], free nymphs perished after about 2½–3 days. On and in lung or liver tissue, they survived for a week. Kept at 2–3°C. [35·6—37·4°F.] they resisted destruction in water for a week, and in lung tissues for about 15 days.

Nymphs were reared to the adult stage in dogs 2 weeks to 8 years old. Superinfections and reinfections of dogs were successfully performed. The sexes lived about the same length of time, and infection appeared to persist for two years. Most dogs were still infected after 102 weeks, but free from parasites after 106 weeks. The position and symptoms of infection are described. Shedding of eggs, which were found in the nasal secretions, began at the commencement of the sixth month after infection and continued throughout the life of the female, though sometimes with intervals of days or even weeks. No eggs were found in droppings ; first-stage larvae were occasionally observed on the surface of the liver and other internal organs of infected dogs, suggesting that swallowed eggs may hatch in the small intestine, but no further development could be seen. Feeding of parts of the uterus of gravid females nearly 2 years old to guineapigs resulted in normal production of large quantities of nymphs.

Experiments with cats indicated that the development and longevity of nymphs in them are limited, but that they might be of insignificant importance as accidental intermediate hosts. Successful infection of two examples of *Citellus* (*Otospermophilus*) *beecheyi* was obtained by feeding them on eggs. Feeding of eggs to pigeons resulted in the formation of tubercles on the internal organs containing the remains of first-stage larvae. Eggs fed to lizards were discharged unaltered in the droppings. Fish fed eagerly on living nymphs, which were killed and partly digested during their passage through the intestine. The nymphs were not able to perforate the intestinal wall.

Barber (M. A.). **The present Status of** ***Anopheles gambiae*** **in Brazil.**—*Amer. J. trop. Med.* **20** no. 2 pp. 249–267, 1 map, 1 chart, 6 refs. Baltimore, Md, 1940.

Details are given of a survey of *Anopheles gambiae*, Giles, on the Jaguaribe river in Ceará, Brazil [*cf. R.A.E.*, B **27** 125] in May–August 1939, a period including the close of the wet and beginning of the dry season. The stretch of river surveyed was about 32 miles long. *A. gambiae* had spread along it from east to west for nearly two-thirds of the distance, and malaria was epidemic over a stretch of about 5 miles at the eastern end. The rivers in this region have fairly high, thinly-wooded banks and broad beds of sand or gravel, and algae are abundant. Along the Jaguaribe river, at a distance of a few hundred yards from it, are dwellings making a nearly continuous village. There are lagoons varying in size from small ponds to large lakes at different distances from the river. Most of the larvae of *A. gambiae* were found in rivers, usually in small pools, free from algae or with the surface free, but some occurred among algae in the stream itself [*cf.* **20** 171]. River-bed pools containing iron hydroxide and the remains of iron bacteria, animal wallows in muddy flats and seepage pools formed by small springs in the banks were less common but prolific breeding places. The larvae were found in only two places in or near lagoons, in both cases in ricefields bordering them. Sometimes as many as 150 adults per room were found in dwellings near the river, but their density

decreased as distance from the river increased. They were found in small numbers in uninhabited buildings, but usually only where there were much larger numbers in the inhabited houses nearby. The ratio of females to males in the daytime resting places varied greatly, but was about 3 : 1 in the total collections from a number of houses from various localities.

It is concluded from a study of malaria in the villages that the invasion of certain areas of Brazil by *A. gambiae* is followed, sometimes after a lapse of several weeks, by epidemic malaria, a result which might be expected where an efficient vector enters a non-immune population. Malaria and malaria vectors were present in this part of Brazil before the advent of *A. gambiae*, and *Plasmodium vivax*, *P. falciparum* and *P. malariae* were found both where *A. gambiae* was present and where it was not. There is no evidence of the presence of any peculiar malaria parasite brought in by *A. gambiae* or habitually carried by it. This Anopheline owes its efficiency as a vector in Brazil to its choice of human hosts, its susceptibility to malaria, and its ability to breed in places situated near dwellings. Collections of *A. gambiae* for dissection were made in dwellings in about 13 different localities and on 27 dates in May–August 1939; 600 gland dissections gave a sporozoite index of 2·7 and 333 stomach dissections an oöcyst index of 9·3.

If the river so diminshes in September and October as to restrict breeding places, there may be a flight of *A. gambiae* from heavily infested to uninfested territory. There is an even greater danger from small breeding places, which may be overlooked during the dry season. When the rains come in the early months of the year, females from these breeding places may find others in unlimited numbers in the freshened water of the lagoons and in the newly formed ponds and pools. To prevent this, larvae should be cleared from the river near the point to which the mosquito has spread, a thorough search should be made of the limited breeding places left in the dry season, and adults should be destroyed at the same period. During summer and early autumn, when breeding is profuse, the output at any place where transport by car, boat or rail is possible should be restricted to the utmost. At present, larvae must be controlled largely by larvicides, of which Paris green is probably the best. Rivers should be stocked with *Gambusia* where it is lacking. The destruction of adults by fly-sprays is recommended for checking an epidemic or lessening the danger of spread by vehicles or natural means. Sleeping rooms may be screened with cloth or netting.

Descriptions of modifications in technique found useful in work with *A. gambiae* are given in an appendix. Paris green can be effectively applied without a dust-gun or sprayer by diluting it at the breeding place with dry, coarse sand or fine gravel, which is as satisfactory as fine sand, and distributing the mixture by hand or with a scoop. The Paris green separates from the sand in the air. In some conditions, it is advisable to use a mixture of 10 oz. Paris green with 1 pint kerosene, which does not separate until the sand reaches the water. The mixture is made in the laboratory and 1 part added to 100 parts moist sand in the field. If the sand is too wet, it will not scatter well, and if it is too dry, the Paris greeen will not separate well on the water. By this method, the mixture can be thrown considerable distances even against the wind, but the spreading must be thorough since no spot missed is covered later, as it would be by the fine green cloud that separates

from the dry mixture. The film formed when the oily particle strikes the water is effective for some distance, but only where there is no surface débris to prevent its spreading.

To avoid the risk of bringing live mosquitos into uninfested territory, those required for dissection may be lightly chloroformed, treated in strong alcohol for a second or two to remove air, quickly washed in water to remove the alcohol, and put into a vial of normal saline, which in turn is put into a thermos bottle supplied with ice, where they remain in a dissectible condition for at least two days.

BOYD (M. F.). **The Influence of Sporozoite Dosage in Vivax Malaria.**—*Amer. J. trop. Med.* **20** no. 2 pp. 279–286, 3 refs. Baltimore, Md, 1940.

When batches of Anophelines infected with *Plasmodium vivax* are used to induce attacks of malaria, they are roughly graded according to quantitative infection estimated by counting the number of oöcysts on the stomachs of some of each batch dissected before infection is mature [*cf.* *R.A.E.*, B **21** 73]. The salivary glands of all the mosquitos fed are examined after application, and the inoculation is recorded as having been effected only by the number in which sporozoites were observed. Data obtained in the course of 394 primary inoculations when varying numbers of Anophelines belonging to different grades were applied are given. From these it is concluded that the dosage of sporozoites of *P. vivax* with which a susceptible person is inoculated, estimated in the manner described, exerts a significant effect on the subsequent infection. If the dosage is small, the number of unsuccessful inoculations will be high. The duration of the incubation period tends to vary inversely with the dosage of sporozoites received [*cf.* **25** 231]. The duration of the primary clinical attack appears to vary directly with the dosage of sporozoites and inversely with the length of the incubation period [*cf.* **27** 132]. Renewed attacks occur most often when the primary attack is induced by heavily infected mosquitos and is terminated artificially. There is little difference in the frequency of renewed attacks after primary attacks induced by lightly or heavily infected mosquitos and terminated naturally and those induced by lightly infected mosquitos and terminated artificially. There is some tendency for persons inoculated by heavily infected mosquitos to experience a greater number of severe paroxysms than do those inoculated by lightly infected ones.

STUNKARD (H. W.). **The Morphology and Life History of the Cestode, *Bertiella studeri*.**—*Amer. J. trop. Med.* **20** no. 2 pp. 305–333, 17 figs., 25 refs. Baltimore, Md, 1940.

When eggs from gravid proglottids of a species of *Bertiella*, tentatively identified as *B. studeri*, from a monkey, *Macacus rhesus*, were fed to 24 species of free-living mites collected near Hamburg, onchospheres and developing larvae were recovered from the body cavity of *Notaspis coleoptratus*, *Scutovertex minutus*, *Scheloribates laevigatus* and *Galumna* sp. Cysticercoids were removed from *S. laevigatus* and *Galumna* sp. This shows that *Bertiella*, like other Anoplocephaline Cestodes [*cf.* *R.A.E.*, B **28** 135], uses free-living mites as intermediate hosts.

Davis (G. E.). *Bacterium tularense*: **Its Persistence in the Tissues of the Argasid Ticks** *Ornithodoros turicata* **and** *O. parkeri*.—*Publ. Hlth Rep.* **55** no. 16 pp. 676–680, 1 ref. Washington, D.C., 1940.

Details are given of experiments in which examples of *Ornithodorus turicata*, Dugès, and *O. parkeri*, Cooley, that had fed on guineapigs infected with tularaemia were allowed to engorge on healthy guineapigs to ascertain whether they would transmit the disease, and in which saline suspensions of their tissues were injected into healthy guineapigs to determine the persistence of *Bacterium tularense* in them. In the experiments with *O. turicata*, 49 examples in various stages of development were given a total of 106 feedings on healthy guineapigs, but none of the latter showed any evidence of infection. The earliest and latest feedings of ticks later proved positive by injection were made 28 and 618 days, respectively, after the infecting feed. Of the 37 ticks injected, 18, including nymphs and adults of both sexes, induced typical tularaemia in guineapigs when injected, the bacteria having persisted in them for up to 674 days. Only one tick was tested at a longer interval (703 days). Feeding and injection experiments with the progeny of infected females of *O. turicata* all gave negative results.

In the experiments with *O. parkeri*, 21 ticks that received the infecting feed as first-instar nymphs were given a total of 52 subsequent feedings, but in no instance did the host guineapig become infected. The earliest and latest feedings of the ticks that later proved positive on injection were 28 and 509 days, respectively, after the infecting feed. Of 11 ticks of this group that survived to be injected, the single female, which was injected after 339 days, failed to induce infection, but the 10 males, injected after 138–701 days, all gave positive results. Four other ticks that were given their infecting feed as late-instar nymphs were injected after intervals of 57–412 days and also gave positive results.

The virulence of the bacteria was not affected by the length of their sojourn in the ticks or by starvation of the latter.

Philip (C. B.). **Ticks** (*Ornithodoros* **spp.**) **in Arizona Bat "Caves."**—*Publ. Hlth Rep.* **55** no. 16 pp. 680–682, 3 refs. Washington, D.C., 1940.

In connection with studies on relapsing fever, observations on ticks of the genus *Ornithodorus* associated with bats were made in mine tunnels in Arizona in September 1939. *O. coprophilus*, McIntosh, which had previously been collected only from bat guano sold locally in Arizona and from bat fertiliser in Mexico, was observed in enormous numbers on guano in the last 50 feet of a mine tunnel 310 feet long in Picacho Mountain. No example of this tick could be found on the ceiling or upper part of the walls, none was taken on the bats and none attempted to attack the author, neither did any of them show evidence of having taken a blood meal. It seems unlikely, therefore, that it is a vector of human disease or that its distribution with commercial bat fertiliser is potentially dangerous. Although it does not appear to parasitise bats, its relationship with these animals may be seasonal; there was no evidence of the use of the "cave" by other possible hosts.

Larvae of an unidentified species of *Ornithodorus* resembling *O. talaje*, Guér., were taken on bats from two other mine tunnels and

3 more, apparently of the same species, on bats collected in the Picacho "cave." In further samples of guano from this last tunnel were found 25 nymphs and 3 adults of a third species of *Ornithodorus*, which is to be described as new.

KOMP (W. H. W.). **The Occurrence of *Anopheles darlingi* Root in British Honduras and Guatemala.**—*Publ. Hlth Rep.* **55** no. 16 pp. 693–694, 6 refs. Washington, D.C., 1940.

Anopheles darlingi, Root, which is the most important vector of malaria in Brazil (except the introduced species, *A. gambiae*, Giles) and in British Guiana and Venezuela, is here recorded from British Honduras and Guatemala. It has not been observed in any of the other Central American countries. In British Honduras, larvae and pupae were found in side pools along a creek, and females engorged with blood were taken in the sleeping quarters at a camp; one female was taken when attempting to bite. The specimens from Guatemala were found in collections.

LEESON (H. S.). **On the Wing Forms of *Anopheles funestus*, Giles.**—*Bull. ent. Res.* **31** pt. 1 pp. 57–58, 2 refs. London, 1940.

Observations on 3 collections of *Anopheles funestus*, Giles, from Fort Johnston, Nyasaland, and of adults derived from eggs laid by females of one of them showed that a female of the type form may produce adults having the wing markings characteristic of any of the four groups previously distinguished [*cf. R.A.E.*, B **26** 75] and not necessarily any with markings of its own group; and that, whereas adults having wings characteristic of the third group (the suggested coastal form) and of the fourth group (rare in East Africa) together constituted only 5 per cent. of the 3 collections, adults of the second group (dark wings) constituted 70 and those of the first group 25 per cent. All these collections were made in May–July 1938, the dry season, and it is not known whether there is any seasonal variation in the wing markings.

NIXON (G. E. J.). **A new African Diapriid (Hym., Proctrupoidea).**—*Bull. ent. Res.* **31** pt. 1 pp. 59–60, 1 fig. London, 1940.

Trichopria lewisi, sp. n., is described from adults of both sexes bred from puparia of *Glossina brevipalpis*, Newst., and *G. fuscipleuris*, Aust., collected at Kabete, Kenya Colony.

DE MEILLON (B.) & LEESON (H. S.). **Notes on Ethiopian Anophelini.**—*Bull. ent. Res.* **31** pt. 1 pp. 61–67, 5 figs., 2 refs. London, 1940.

This paper includes descriptions of the adults of both sexes and associated larval and pupal pelts of *Anopheles michaeli*, sp. n., the larval and pupal pelts of *A. walravensi*, Edw., and the eggs of *A. argenteolobatus*, Gough, and *A. distinctus*, Newst. & Cart., all from Ndola, Northern Rhodesia, and of the female of *A. tchekedii*, sp. n., from Okavango Swamp, Bechuanaland. The last-named species was taken in 1935 by W. A. Lamborn, who stated that the females were very numerous, biting late in the afternoon, and that cattle were literally covered with them. Atypical examples of *A. argenteolobatus* and *A. domicolus*, Edw., are recorded from Northern Rhodesia and from Northern and Southern Rhodesia, respectively.

Nash (T. A. M.). **The Effect upon *Glossina* of changing the Climate in the True Habitat by Partial Clearing of Vegetation.**—*Bull. ent. Res.* **31** pt. 1 pp. 69–84, 2 pls., 4 figs., 10 refs. London, 1940.

An account is given of the results of an experiment carried out at Gadau, Northern Nigeria, to determine the effect on *Glossina morsitans*, Westw. [race *submorsitans*, Newst.] and *G. tachinoides*, Westw., firstly of removing the thicket windbreak round one of the residual forest islands to which both these species concentrate for protection from the high temperature and evaporation of the late dry season, and secondly of thinning the seedlings of ebony (*Diospyros mespiliformis*) so that they no longer formed clumps on the forest floor within the island.

Preliminary investigations carried out from April 1936 to September 1937 showed that the climates of this island and of a control island separated from it by 330 yards of barrier clearing were very similar. During this period, data were obtained in the two islands on the relative densities of both adults and pupae and on pupal mortality. In October 1937, the impenetrable bramble-like thicket surrounding the experimental island was removed [*R.A.E.*, B **27** 201] and the trunks of the huge creepers that festooned the tops of the trees were severed, but left in position. The effects of these measures upon the climate and fly were observed for a year, and as it was found that *G. tachinoides* persisted in small numbers, the clumps of seedling ebonies were thinned in October 1938.

The following is taken largely from the author's summary: The removal of the thicket considerably altered the climate of the island. The evaporation rate became much higher, and increases occurred in the atmospheric diurnal temperature and, particularly, in the soil temperature. The thinning of the seedlings accentuated these changes, especially evaporation near the soil surface. As a result, the population of *G. tachinoides* steadily decreased from the end of the rains with the rising evaporation; pupal mortality increased and pupal density decreased until breeding practically stopped at the end of the cold season and ceased altogether in the hot weather; by the late dry season, the virtual extermination of the species had taken place. Increased evaporation is considered to have been much more important than increased temperature in bringing about this destruction. The successful re-colonisation of the island in the rains proved that wet season climatic conditions are much more favourable to tsetse flies than those of the dry season. *G. morsitans* continued to concentrate in the island, but the local increase in population in the dry season failed to take place. It is believed that immigration just counterbalanced the increasing death rate. Although *G. morsitans* is also affected adversely by high evaporation, it is much more resistant than *G. tachinoides*, possibly because it loses water less readily at the same evaporation rate. It manages to avoid lethal, mid-day shade temperatures by resting at ground level in hollow trees and crevices between roots. Throughout Africa it has been found that, to be effective against *G. morsitans*, clearing must be ruthless.

As a result of this experiment, partial clearing of riverine vegetation that lines the banks of streams has been carried out against *G. tachinoides* on a large scale and has been found to lead to complete extermination. It is also likely to be effective against *G. palpalis*, R.-D., in the drier part of its range. The amount of vegetation spared must depend on the local climate; the higher the dry season evaporation

rate, the less the clearing that will be required. Another type of partial clearing is being evolved for localities in hilly country, where the upper reaches of a stream fail to contain water except in the rains, and concentrations of fly have been located in the late dry season around occasional pools. It is hoped that the fly will be exterminated by clearing carried out at these spots provided that a long barrier clearing is made lower down the stream, at the point where permanent water starts, to prevent re-infestation in the wet season. As yet, there has been no tendency for the streams to dry up after clearing; the water lost by evaporation through increased exposure to the sun is probably less than the amount conserved by destroying dense masses of transpiring vegetation. For small, isolated protective clearings on streams, drastic felling is necessary; the clearings on each side of a ford or village water hole should be 300 yards long against *G. tachinoides* and 400 yards long against *G. palpalis*. These distances have proved inadequate for permanently flowing rivers where the moister, cooler conditions enable the fly to cross longer barriers during the rains. Clearing against *G. morsitans* must be both ruthless and extensive, and is inadvisable in Nigeria unless large sums of money are available and the density of the populations is such that many will benefit.

TULLOCH (G. S.). **Ecological Notes on Mosquitoes associated with Bromeliads.**—*J. Agric. Univ. P. R.* **22** no. 4 pp. 499–501. Río Piedras, P.R., 1939. [Recd. 1940.]

In the mountains of Porto Rico, large numbers of mosquito larvae are found in water in the leaf-basins of Bromeliads. Observations were made on the temperature and pH of the water in which species of *Culex*, *Wyeomyia* and *Corethrella* were found, and these are summarised in a table.

PAPERS NOTICED BY TITLE ONLY.

MAZZA (S.), GAJARDO TOBAR (R.) & JÖRG (M. E.). **Investigaciones sobre Triatomidae. *Mepraia* novum genus de Triatomidae. *Mepraia spinolai* (Porter) 1933, nov. comb., redescripción de ♂ y descripción de ♀.** [*Mepraia*, gen. n., for *Triatoma spinolai*, Porter, from Chile.]—*Publ. Misión Estud. Pat. reg. argent. Jujuy, Univ. B. Aires* no. 44, 30 pp., 27 figs., 8 refs. Buenos Aires, 1940.

MAZZOTTI (L.). **Una nueva especie de *Triatoma* en Mexico.** [A new Species of *Triatoma* from Mexico; *T. hegneri*, sp. n., from an ancient ruin.]—*Ciencia* **1** no. 1 pp. 22–23, 1 fig. Mexico, D.F., 1940.

VARGAS (L.). **Clave para identificar las larvas de *Anopheles* mexicanos.** [A Key to the Larvae of the Mexican Species of *Anopheles*.]—*Ciencia* **1** no. 2 pp. 66–68. Mexico, D.F., 1940.

DEL PONTE (E.). **Observaciones sobre *Anopheles pseudopunctipennis* en La Mendieta.** [Observations on *A. pseudopunctipennis*, Theo., at La Mendieta, Argentina.]—*Bol. sanit. Dep. Hig. Argent.* **3** no. 9 pp. 571–577. Buenos Aires, 1939. [Recd. 1940.] [*Cf. R.A.E.*, B **28** 152.]

Kirk (R.). **Studies in Leishmaniasis in the Anglo-Egyptian Sudan. Part I. Epidemiology and General Considerations.**—*Trans. R. Soc. trop. Med. Hyg.* **32** no. 4 pp. 533–544, 1 map, 34 refs. London, 1939.

Kirk (R.) & Mohammed Hamad Sati. **II.—The Skin and Lymph Glands in Kala-azar.**—*Op. cit.* **33** no. 5 pp. 501–506, 10 refs. 1940.

Kirk (R.) & Lewis (D. J.). **III.—The Sandflies** (*Phlebotomus*) **of the Sudan.**—*T.c.* no. 6 pp. 623–634, 1 pl., 3 figs., 1 map, 26 refs.

In the first of these papers, it is pointed out that the epidemiology of visceral leishmaniasis in the Anglo-Egyptian Sudan [*cf. R.A.E.*, B **25** 106] differs from that usual in the Old World, but resembles, in many features, that observed in Brazil [*cf.* **25** 15 ; **26** 89]. There is a significant correspondence in the rural rather than urban incidence of the disease ; in its wide, scanty and erratic distribution, unrelated to the density of population and most frequently associated with water and wooded country ; in the absence of canine leishmaniasis [but *cf.* **27** 66, 158, 245] or epidemic types of the human disease ; and in the occurrence in both countries of nasopharyngeal leishmaniasis or espundia. There are three endemic areas in the Sudan, and there is no evidence that they have extended appreciably during the last 30 years, in spite of the opening-up of communications. It may be expected that the disease is transmitted by a species of *Phlebotomus* of the group of *P. major*, Annan., and recent observations suggest that *P. langeroni*, Nitzu., may be the species concerned, but the epidemiological picture implies something more than a direct transmission from man to man by sandflies. Such transmission would not explain the sporadic cases and the outbreaks that have occurred during military operations in uninhabited territory. The only explanation seems to be that in the absence of man the infection can be carried on by some alternative or reservoir host. The rural distribution of the disease, and its occupational incidence in tramps, wood-cutters and the like, are in accord with this view. So also is the association of kala-azar in the Sudan with nasopharyngeal leishmaniasis, which in South America (British Guiana) is so frankly regarded as a disease of the jungle that it bears the name of " forest yaws."

In the third paper, the authors give the general distribution in the Sudan of the prevalent species of *Phlebotomus*, basing their work on previous records [*cf.* **1** 34 ; **21** 27 ; **28** 16] and on observations carried out in 1938 in the course of which over 1,300 sandflies from different parts of the country were caught and identified. The methods used in collecting sandflies and in mounting them for identification are described. As the specimen of *P. langeroni* recorded from El Fasher [**26** 194] was damaged, it was impossible to determine whether or not it was var. *orientalis*, Parr., but further specimens taken by the authors in the Blue Nile area have all proved to belong to this variety, which was the only sandfly taken of the group of *P. major*. In addition to the typical variety of *P. schwetzi*, Adl., Thdr. & Parr., the authors record var. *aethiopicus*, Parr. ; *P. adleri*, Thdr., was also identified. All the 13 species and varieties recorded were captured in hospital wards, houses, stables and other buildings, where they often appear in large numbers in the evenings. Although many of them may pass the rest of the day in inconspicuous situations indoors, especially where the interior conditions are favourable to their breeding, there

is little doubt that numbers actually enter these places in the evening from outside. For this reason the authors studied principally the bionomics of sandflies in outdoor situations. Most of the species recorded have been collected in the wilderness, often in uninhabited country. Species that bite man are often less prevalent in the village itself than in the cultivated country round it or at the nearest watering place, which may be a considerable distance away. Sandflies were readily taken in animal burrows, those recorded being *P. clydei*, Sinton, *P. africanus*, Newst., *P. minutus* var. *signatipennis*, Newst., *P. squamipleuris*, Newst. and *P. schwetzi*. In central Sudan, sandflies occur throughout the year, the biting species being particularly abundant and annoying from March to July. They almost disappear during the heavy rains in many places, but reappear soon afterwards. A diurnal periodicity was observed even in outdoor situations, the sandflies appearing in certain situations just before sunset, just after dawn, etc. ; the significance of these movements is somewhat obscure. *P. schwetzi*, *P. congolensis*, Beq. & Walr., *P. langeroni* var. *orientalis* [*cf.* **27** 34] and *P. papatasii*, Scop., are already known to bite man. The record of a single example of *P. africanus* caught during the act of biting shows that this species also attacks man, although man is evidently not its normal host. *P. clydei* has been found to bite man viciously in considerable numbers. Unidentified mites have been found on *P. minutus* var. *signatipennis* and on *P. papatasii*, and *P. africanus* has been found infested with a fungus.

STRICKLAND (C.), ROY (D. N.) & SEN GUPTA (S. C.). *Anopheles maculatus* **and Malaria.**—*Trans. R. Soc. trop. Med. Hyg.* **33** no. 6 pp. 639–652, 21 refs. London, 1940.

The authors describe experiments in which 204 examples of *Anopheles maculatus*, Theo., reared from larvae collected in the Bengal Dooars and the Darjeeling Terai were tested in Calcutta and in the Dooars to determine their susceptibility to infection with malaria parasites. In Calcutta, no tests were made with *Plasmodium malariae*, and of 23 examples tested with *P. vivax*, none became infected, whereas out of 91 tested with *P. falciparum*, 23 and 9 contained oöcysts and sporozoites, respectively. In the Dooars, the numbers showing oöcysts and sporozoites were 3 and 0 out of 6 tested with *P. malariae*, 12 and 0 out of 21 with *P. vivax* and 29 and 15 out of 63 with *P. falciparum*. Thus, gland infections were obtained only with *P. falciparum*. The tests in Calcutta were carried out at all seasons and those in the Dooars from August to February only. In Calcutta, of the 38 kept in the laboratory, where the conditions of temperature and humidity were uncontrolled, none showed sporozoites and only 4 showed oöcysts, whereas of the 76 kept in the cool room, where these conditions were controlled, 9 showed sporozoites and 19 oöcysts. In the Dooars, 16 experiments were carried out, five of them in August, and it was in these that the 15 gland infections already mentioned were observed. In experiments carried out in Calcutta in which *A. stephensi*, List., was used as a control [*cf. R.A.E.*, B **28** 164], 6 out of 22 of *A. maculatus* and 5 out of 23 of *A. stephensi* showed gland infections when tested in the cool room with *P. falciparum*, and 0 out of 11 and 3 out of 17 showed gland infections when tested in the laboratory with *P. falciparum* and 0 out of 7 and 10 out of 15 when tested with *P. vivax*.

As the results even in the Dooars appeared to be rather poor if the species were really responsible for the very severe incidence of malaria that occurs in the submontane zone of the Himalayas, several batches were sent to Malaya and their susceptibility to *P. falciparum* was tested against that of the local strain of *A. maculatus*; the results indicated that the two strains, which were kept at temperatures ranging between 73 and 82°F. with a mean relative humidity of about 85 per cent. or higher, were about equally susceptible, the sporozoite rates being 45·4 per cent. in the Indian strain and 40·0 per cent. in the Malayan strain. In view of these results, it is concluded that the Malayan strain of *P. falciparum* is more highly infective than the strains used in the experiments in India. The very severe incidence of malaria in the submontane region may be partly accounted for by the small number of cattle and partly by the excessive prevalence of *A. maculatus*.

CORRADETTI (A.). **Descrizione dell'** *Anopheles* (*Neocellia*) *dancalicus*.—*Riv. Parassit.* **4** no. 1 pp. 31–44, 8 figs., 1 pl. Rome, 1940.

Detailed descriptions are given of the adults, larva and pupa of *Anopheles dancalicus*, Corradetti [*cf. R.A.E.*, B **28** 62]. The Dobi Valley, in Abyssinia, in which the larva were taken, forms a completely enclosed basin, of which the floor consists of sediment with a salty crust. Larvae and pupae were numerous in small pools among such incrustations. No other Anophelines were associated with them. Larvae taken to an altitude of about 8,000 ft. developed to the adult stage in spite of the different climate. No adults were captured in the dwellings of labourers working on the Assab-Dessie road, or elsewhere, and no complaints were made of bites at night.

Moribund Flies . . . Where do they figure in counting "deads" under the Peet-Grady Procedure?—*Soap* **16** no. 5 pp. 98–99, 101, 103, 117. New York, N.Y., 1940.

The question whether, in tests of liquid household insecticides by the Peet-Grady method on house-flies [*Musca domestica*, L.], "moribund" individuals should be counted as dead was discussed at the meetings of the Insecticide Scientific Committee of the National Association of the Insecticide and Disinfectant Manufacturers. The Reports made by members of the Committee to the Association are given in this paper, with the exception of that by H. E. Whitmire, the substance of which was essentially that of a paper already noticed [*R.A.E.*, B **28** 79], and record divergent views.

SANDERS (D. A.). *Musca domestica* **a Vector of Bovine Mastitis (Preliminary Report).**—*J. Amer. vet. med. Ass.* **97** no. 761 pp. 120–122, 3 figs., 8 refs. Chicago, Ill., 1940.

The prevalence of bovine mastitis (which refers in this report to an invasion of the udder through the teat canal by microörganisms) in several dairy herds in Florida led to investigations, begun in April 1940, on the transmission of the disease. It was observed that *Musca domestica*, L., was abundant on the floors of milking sheds and barns where mastitis had occurred, feeding on milk spilt during milking, and that it crawled over the surface of the teats of cattle in the milking

line to feed at the external orifices. Examination of infected animals near the barns during the day showed that the fly was persistent in its habit of feeding at the opening of the teat ducts and in crawling or flying from one teat to another on the same or on a different animal. Experiments were therefore undertaken to determine whether this fly could act as a vector. Examples caught on infected premises were confined in cages and fed for 3-7 days on heavily infected milk. After being without food for a short time, they were transferred to large Berkefeld mantles. The teat of an uninfected cow kept in a screened sanitary isolation building was inserted into the opening at the base of the mantle, and the flies fed readily on the small droplets of lactic secretion that had been carefully pressed from the teat to attract them to the orifice. After consuming the milk, they were often seen to insert the proboscis into the orifice to seek further milk, using a mop-like action. While they were crawling over the tip of the teat, the feet were often placed deep in the fossa, which is a very pronounced anatomical structure in some lactating cows. After a teat orifice had been exposed in this manner, a small droplet of milk was purposely squeezed out and allowed to remain on the tip of the teat. Multiple exposures of the external teat orifice were made in each experiment. In other experiments, several hundreds of flies were released inside the screened enclosure, milk from diseased udders was incubated overnight and exposed to the flies, and lactating cows free from mastitis were placed in the enclosure. Mastitis developed in each of several experimental animals when either method of exposure was used, thus proving that *M. domestica* is a natural vector. Infections were readily established in udders when the lactic secretion was allowed to remain in the quarters as it does when cows are being " dried off " prior to calving.

Stiles (G. W.). **Anaplasmosis in Cattle.**—*Circ. U.S. Dep. Agric.* no. 154 (revd.), 10 pp., 3 figs., 1 ref. Washington, D.C., 1939. [Recd. 1940.]

In this circular on anaplasmosis in cattle in the United States, which is a revision of one already noticed [*R.A.E.*, B **19** 203], lists are given of 17 ticks that have been shown to transmit the disease under experimental conditions in various parts of the world and 6 species of *Tabanus* that have similarly been shown to do so in the United States.

Bishopp (F. C.). **The Stablefly: How to prevent its Annoyance and its Losses to Livestock.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1097, 3rd edn, 18 pp., 11 figs. Washington, D.C., 1939. [Recd. 1940.]

This bulletin on *Stomoxys calcitrans*, L., one of the most important causes of annoyance to livestock in the United States, is a revision of one already noticed [*R.A.E.*, B **19** 262]. If abundant, this fly may draw so much blood from animals as to kill them or, notably in the case of cattle infected with Texas fever [*Piroplasma bigeminum*], greatly increase the normal mortality due to disease. It also probably acts as a mechanical carrier of anthrax and the disease of horses known as swamp fever or infectious anaemia. Moreover, it attacks man and is thought to be concerned in the transmission of infantile paralysis and other human diseases. It occurs throughout the United States,

but is most troublesome in the central States. Severe outbreaks occur from time to time, and injury is most severe during August and September.

The egg, larval and pupal stages last 1–3, 11–30 and 6–20 days under favourable conditions. The normal breeding medium is damp straw, oat straw being more favourable than wheat straw as it is softer. Breeding may take place in pure horse dung, but is more usual in a mixture of dung and straw. It has also been observed in broken-up masses of hay or dead grass, maize husks and silage, and is believed to occur in windrows of seaweed [**25** 132]. Larvae have been reared experimentally in cow dung, but this seems to be unattractive. Breeding in human excrement has never been observed. The material in which larvae are developing must be moist. Pupation occurs anywhere in the breeding material.

The adults of both sexes feed on blood. They engorge in 2–5 minutes and may do so twice in a day if the weather is warm. When the proboscis is withdrawn, a drop of blood usually exudes from the wound, which is often frequented by numerous small flies and probably attracts oviposition by *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.). The animals attacked include pigs, dogs, cats, sheep and goats, but horses and cattle are preferred. The flies also feed on the moisture on fresh manure and rotting straw and to some extent on succulent fruit and have been observed to take water. At least three blood-meals or more in cool weather, appear to be necessary before the first eggs are produced. The females sometimes crawl several inches into loose straw to oviposit. The eggs are laid in irregular masses, sometimes of 25 or more, or occasionally singly. The greatest number of eggs which a female was observed to deposit between blood-meals was 122, and throughout life, 632. Oviposition is commonly repeated three or more times, and it is sometimes necessary, especially in cool weather, for a female to engorge twice between each oviposition. In captivity, a few adults among a considerable number kept in large cages with cattle and suitable material for oviposition lived 29 days. In the southern United States, there is no true hibernation. In the north, few adults emerge in the winter, which is usually passed in the larval and pupal stages.

No flies appear to be killed by a temperature that does not fall below 27°F. The lowest temperature at which flies were observed to take a blood-meal was 55°F. They feed in cloudy or sunny weather and during rain. Larvae are killed by desiccation, flooding, excessive heat and light. The pupae are much less susceptible to extremes of climate, but are attacked by two species of parasites, which sometimes destroy as many as 40 per cent. and of which one, *Spalangia muscidarum*, Richardson, has a wide distribution in the United States.

Animals may be protected from attack to some extent by covering them with blankets made of a double thickness of burlap and by leather nets or strips of leather attached to the bridle to protect the head. A repellent mixture of 1 U.S. gal. fish-oil, 2 oz. oil of pine tar, 2 oz. oil of pennyroyal and ½ U.S. pint kerosene applied lightly but thoroughly to the parts not covered with blankets or nets is fairly effective. Kerosene extract of pyrethrum is a good spray against the adults. Completely darkened stables offer much protection, but the resulting lack of ventilation is harmful ; for this reason, the thorough screening of all windows and doors is preferable. Care must be taken to brush all flies from the animals as they enter. A description is given

of a trap similar to one already noticed [**22** 59] designed to fit over a window and catch adults entering or leaving barns. Nearly 5 U.S. quarts of flies, of which 90 per cent. were *S. calcitrans*, were caught in one of these traps in 4 months. Flies are sometimes driven from large barns into the traps by forcing live steam into the building. Electrified grids in windows have also been found useful for killing the flies. Little can be done to protect range stock, but a freshly ploughed trench offers considerable protection to pigs. The sides may be smeared with petroleum, which is rubbed off on to the animals and acts as a repellent. The trench may also be used for sheep, but in their case the petroleum is unnecessary.

Allowing manure to accumulate outside a stable and leaving stacks of straw in the fields after threshing with self-stacking machines favour the development of *S. calcitrans*. Outbreaks occur when stacks become wet soon after threshing, and the flies breed in the fermenting straw.

To prevent breeding, the sides of stacks should be made almost vertical and the top well rounded so that the rain drains off. Loose straw and chaff should be burned or scattered. Straw not required for livestock should be scattered and ploughed under or burnt. In regions of heavy rainfall, oat straw should be baled and stored under cover. All straw not consumed during the winter should be promptly disposed of in early spring. The prevention of breeding in manure is also necessary ; manure boxes provided with a trap on top to catch the flies that breed out are very satisfactory for small farms.

RITCHIE (J.). **Sheep Blowflies in Britain and their Control.**—*Agriculture* **47** no. 1 pp. 62–68, 5 refs. London, 1940.

In view of the necessity under war-time conditions of increased efforts to prevent losses among sheep in Britain due to attack by blowflies, particularly *Lucilia sericata*, Mg., which is by far the most important of them, the author explains the methods that can be undertaken by sheep farmers to reduce attack and the information obtained on the life-history of the fly on which such suggestions are based.

Since the maggots that have hibernated in the soil work their way to within a ¼ inch of the surface from the end of March to about the middle of April [*cf. R.A.E.*, B **22** 132], turning over, at that period, the soil of the small field or fold in which many farmers are wont to collect infested sheep will destroy many of the maggots and expose others to the attacks of insectivorous birds at a time when they are particularly active owing to scarcity of food. Egg-laying flies avoid wind and shade, and are most active when the weather is warm and the sun is shining [*cf.* **25** 210] ; if sheep have access to a clump of trees, particularly one situated on a knoll and so exposed to any breeze, they will shelter from the heat there and so avoid the flies at times when they are most active. Flies are attracted to individual sheep by smells associated with moisture, generally that accompanying decay ; thus they attack particularly sheep having wool contaminated by the bacteria causing wool-rot, by discharge from foot-rot or open sores, or generally as a result of scouring, by urine and faeces [*cf.* **25** 282]. If such contamination can be avoided or reduced by careful management, attractiveness will be lowered. The most important requirements for hatching and development of the maggots are

adequate moisture and temperature, and these are most likely to be found together at the base of the wool, where the sheep's body provides the most favourable temperature (approximately 90–100°F.) and perspiration contributes to the moisture. These factors also explain why strikes are more frequent in warm showery weather when intermittent sunshine stimulates fly activity. The moisture-retaining properties of fleeces may account for the fact that certain breeds of sheep are more liable to attack than others and for the seasonal cycle of attacks first on ewes, then, when these are shorn, on lambs, and, finally, on both ewes and lambs at once. The fleeces of sheep on open, wind-swept pastures dry rapidly. Keeping heather short, destroying bracken, and reducing the amount of rank grasses and rushes will lessen the chances of the fleece remaining wet, and rapid drying may be promoted by providing the sheep with sand holes where they may rub or by giving them access to a wood or clump of trees where fine, loose and dry soil occurs plentifully about the tree roots. Other measures that may be taken include dipping to repel the flies and kill eggs and maggots, dressing strikes to kill maggots and promote healing, removing dead maggots from the fleece [*cf.* **25** 209], burying carrion after poisoning the maggots infesting it, and using the carcasses of small animals to act as traps by suspending them over water so that the migrating full-grown maggots will be destroyed by drowning [but *cf.* **25** 211].

EICHLER (W.). **Ueber Dassellarven vom Elch** (*Alces alces* **L.**) **(Untersuchungen über Hypodermiden. I.).** [On Warble Fly Larvae from Elk (Investigations on *Hypoderma*. I.).]—*Z. Parasitenk.* **10** pt. 5 pp. 549–552, 7 refs. Berlin, 1938. [Recd. 1940.]

Larvae from the hide of an elk (*Alces alces*) in Prussia were received for identification in 1938 and were found to be those of *Hypoderma diana*, Brauer. In 1936, Ullrich described three larvae obtained from elk in the same locality as a new species, *H. alcis*, but from an examination of them, the author concludes that they also are larvae of *H. diana*. There is no evidence of the occurrence of an Oestrid specific to elk.

SONI (B. N.). **Warble-fly Larva as an Oesophageal Parasite of Goats.**—*Indian J. Ent.* **1** pt. 3 p. 95. New Delhi, 1939.

Young larvae of *Hypoderma lineatum*, Vill., were found under the submucosa of the oesophagus of a goat, in Mukteswar, United Provinces. This is thought to be the first record of the occurrence of an oesophageal form of this parasite in goats.

GOODRICH jr. (A. L.). **Starling Attacks upon Warble infested Cattle in the Great Plains Area.**—*J. Kans. ent. Soc.* **13** no. 2 pp. 33–40, 22 refs. Manhattan, Kans., 1940.

The harmful and beneficial activities of the starling (*Sturnus vulgaris*), which was introduced into the United States towards the end of the nineteenth century, are discussed from the literature. Throughout the winters of 1937 and 1938, stockmen in two counties in Kansas stated that they had seen starlings apparently extracting larvae of *Hypoderma* from warbles in the backs of cattle ; and numerous

reports were made in several of the mid-western States in January 1940 that these birds were not only attacking the warbles, but also feeding on the surrounding flesh, making large and deep wounds and causing herds to stampede. They also fed on cattle bearing brand wounds. The attacks in 1940 were associated with a severe and prolonged period of cold weather and snow throughout the Middle West. Experiments have indicated that a high degree of relief from starling attack may be obtained by squeezing the larvae from the warbles as soon as they are large enough to make this practicable, and it has been suggested that small herds should be treated three times, and large herds at least twice, during the late winter months. This permits the early healing of the breathing aperture and prevents the making of a flesh wound or infection of the warble by attacks by the birds. It is thought, however, that the combination of abundance of starlings and extremely severe weather at the time when the warbles are present on the backs of the cattle, which was responsible for the heavy starling attacks of January 1940, may not soon recur.

BRUCE (W. G.). **The Medication of Cattle for the Control of Horn Flies.**—*J. Kans. ent. Soc.* **13** no. 2 pp. 41–43, 2 refs. Manhattan, Kans., 1940.

Experiments on the administration of chemicals to cattle by the mouth to render the droppings unsuitable for the development of larvae of *Lyperosia* (*Haemotobia*) *irritans*, L. [*R.A.E.*, B **26** 197; **28** 133] were continued in 1939, when 68 tests were made with 29 chemicals with a view to finding one that would be toxic to the larvae but harmless to cattle, as phenothiazine [thiodiphenylamine], the material previously tested, had undesirable qualities making it unfit for general use. The procedure is described. The chemicals were administered either in bran or water or in a capsule. Only 3 other than phenothiazine gave a complete kill at the doses tested, and 2 of these (which had to be administered in capsules) were considered unsuitable for practical use. The fourth, rotenone, which was administered in bran, was effective at much smaller doses than any other substance and had no apparent harmful effect on the cattle. The minimum dose to give complete kill was 0·4 gm. per cwt. body weight, which rendered the droppings unfavourable for the development of larvae from about the 10th until the 40th hour after it had been administered. The minimum effective dose was 0·3 gm. per cwt. administered daily. This dosage allowed the emergence of a few flies, but they were so weak that it is improbable that they would be able to reproduce.

SMART (J.). **Simuliidae (Dipt.) from British Guiana and the Lesser Antilles.**—*Trans. R. ent. Soc. Lond.* **90** pt. 1 pp. 1–11, 4 pls., 3 figs., 16 refs. London, 1940.

A key is given to the females of the 11 species of *Simulium* recorded from British Guiana and the Lesser Antilles, comprising 6 from British Guiana, 3 from Trinidad, 1 from Tobago, 1 from Montserrat and 1 from St. Vincent, and also 10 species from neighbouring countries, which it is thought may be found in British Guiana or the Lesser Antilles in the future. It is followed by notes on the distribution of each of these species, on the habits and breeding places of three of those observed by the author in British Guiana, and on the possible occurrence there of a Venezuelan species described from pupae only.

ANDERSON (C.). & LEHUCHER (P.). **Premier cas d'onchocercose cutanée observé en Tunisie.**—*Arch. Inst. Pasteur Tunis* **29** no. 1 pp. 105–112, 3 figs., 6 refs. Tunis, 1940.

A tumour on the ball of the thumb of a French boy living in Tunis examined in 1925 was found to contain *Onchocerca*, probably *O. volvulus*. There was a focus of *O. volvulus* among Senegalese troops near the boy's home, and Simuliids were taken a few miles away in 1935. These were identified as *Simulium reptans*, L. This is the only record of a case of cutaneous onchocercosis acquired in north Africa.

MCMAHON (J. P.). *Onchocerca volvulus* **and its Vector in the South Kavirondo District of Kenya.**—*Trans. R. Soc. trop. Med. Hyg.* **34** no. 1 pp. 65–83, 2 pls., 3 maps, 12 refs. London, 1940.

The data presented in this paper were collected during a preliminary investigation of the South Kavirondo District of Kenya, where a focus of long-standing infection by *Onchocerca volvulus* in the native reserve had been discovered by G. B. Harris. The infected area, the climate and the activities of the population are described. Out of 605 men, women and children examined for *O. volvulus*, 51 per cent. were positive. In a search for the vector, 1,369 females of the genus *Simulium* were caught, all of which, with the exception of one individual of *S. dentulosum*, Roub., were *S. neavei*, Roub. No males were taken. The area is crossed from south-east to north-west by two rivers which ultimately join and one of which has three tributaries. The fly density was greatest between the second and third tributaries, where the "fly index," that is, the number of flies 3 boys would catch in 8 hours, was 126. This part of the river is densely wooded on both banks and contains a number of waterfalls and cascades, but fewer than the portion between the first and second tributaries [*cf. R.A.E.*, B **27** 267]. The lowest indices were recorded on the upper parts of the two main rivers, where bush gave place to grass and tall reeds, and on a tributary with no bordering vegetation at all. Of 484 flies dissected on the day on which they were caught, 10·1 per cent. were infected. The percentages of flies infected were highest where fly densities were lowest, presumably because, when the fly leaves the bush for comparatively open country, which it does reluctantly, it is in closer contact with man and consequently more likely to become infected. The highest percentage of infected flies was obtained in catches made near fords and other places where people tend to congregate. High fly density was correlated with high incidence of onchocercosis in man, 98 per cent. of the population being infected in reaches where the fly index was 100 and 126, and 38 per cent. where it was 20. The region of lowest infection (13 per cent.) was, at its nearest, 1½ miles from the river, which the people have little cause to visit, as they draw their water from a small sunlit stream running through their land, which is free from bush and therefore unfavourable for the fly. The flies were active on both hot and cool days. Experimental catches organised to give some indication of the influence of shade and weather conditions on their range of flight showed that dense thicket is apparently not attractive, perhaps because of its physical hindrance to flight. In light shade, the first 200 yards of river vegetation appeared to harbour most of the flies. However, on a dull day, they travelled quite readily to a distance of 300 yards from the river. There were indications

that 700 yards is near the maximum range of flight, though it may be greater in dull weather. In simultaneous catches in the open and in shade on sunny days, very few flies were caught in the sun. No adults were found in an examination of the interior of 22 huts. None of the females that were tested by the precipitin method contained human or bovine blood. It is probable that as all captures were of flies that came to the searchers, all were hungry. Attempts were made to infect laboratory animals by the bite of *S. neavei*, but in no case were the females observed to feed.

Searches for larvae and pupae on rocks in waterfalls, vines, grasses, tree roots, boulders and stones in aerated and non-aerated water and in moss, earth and mud on the banks yielded immature stages of 8 named and one undescribed species of *Simulium*, but not of *S. neavei*. The breeding places in which each of the 8 named species was found are described.

HAFEZ (M.). **Some Ecological Observations on the Insect Fauna of Dung.**—*Bull. Soc. Fouad 1er Ent.* **23** pp. 241–287, 8 figs., 6 tables, 4 pp. refs. Cairo, 1939. [Recd. 1940.]

A detailed account is given of observations and experiments on the fauna of dung in Egypt, with particular reference to the habits of *Musca domestica vicina*, Macq., the common house-fly in that country. After reviewing the somewhat scanty literature on the fauna of dung and indicating the methods used in his experiments, the author describes the changes that take place with age in different kinds of dung, the different insects that are found on successive days, and the influence of the ageing of the dung on the numbers of the different insects present in it. A systematic list is then given of the insects, showing whether they breed in the dung or merely visit it, and the maximum numbers of individuals of each species caught or bred per pound of dung. Brief records of observations on the bionomics of some of the beetles and flies are followed by a more detailed account of studies on the breeding media of some of the common dung flies, especially *M. d. vicina*, carried out on farms and in stables in the region of Cairo and in the country, and of the results of oviposition experiments in the laboratory in Cairo.

The favourite breeding media of *M. d. vicina* appear to be horse dung in and near Cairo, where horses are common, and donkey dung in the country, where donkeys are the main beasts of burden and the chief means of transport. In both cases, the stables are infrequently cleaned, but fresh litter is supplied, so that the floors are covered with a fairly thick layer of dung kept moist by the urine of the animals, and larvae are extremely abundant in this. Oviposition does not take place in single horse droppings scattered in fields and on roads, probably because they dry up too rapidly and are broken up by birds. The larvae can be found in some, but not all, of the small heaps deposited in the fields, their presence probably depending on the temperature of the dung. In small masses, the temperature of the surface layers is about 25–35°C. [77–95°F.] and ovipositing females are attracted, whereas if the dung is piled in cone-shaped heaps, fermentation takes place and the surface temperature may be sufficiently high to be repellent. On farms, the excreta of donkeys, cows and buffalos are collected, mixed and made into disks about 3 cm. thick that are baked in the sun and used as fuel. No larvae of *M. d. vicina* were seen

in these disks, and where this is done, donkey dung may be of no importance. The great bulk of dung on farms is that of cows and buffalos, but *M. d. vicina* will only exceptionally oviposit in such dung, and in only two instances were larvae found in significant numbers in it. Pig dung is more attractive to this fly than horse dung, but is of less importance, owing to the limited distribution of pigs in Egypt. Camel dung is much less attractive than horse dung.

Other species of *Musca* and species of *Sepsis* were found to breed mainly in the cow and buffalo dung that accumulates in byres and fields, but the importance of these breeding media is decreased by the prevalent habit of making them into disks for fuel. Any larvae that hatch are probably killed by exposure of the disks to the sun during the summer, although they may survive and complete their development during the autumn and winter, when the disks take about a week to dry. Borborids of the genus *Leptocera* breed in enormous numbers in the dung of horses and camels, but they are rarely seen in that of cows and buffalos and were never bred from pig dung.

In general, the results of the oviposition experiments, in which the five kinds of dung mentioned were exposed in frames in the open, confirmed the observations made in the field.

De Meillon (B.). [**Report of the Department of**] **Entomology.**—*Rep. S. Afr. Inst. med. Res.* 1939 pp. 30–37, 7 refs. Johannesburg [1940].

Some of the information in this report has been noticed from other sources [*R.A.E.*, B **28** 24, 177, 178]. *Anopheles gambiae*, Giles, *A. funestus*, Giles, and *Aëdes aegypti*, L., were included in a collection of mosquitos received from Angola. In connection with the finding of *Anopheles gambiae* on the Witwatersrand early in 1939 [*cf.* **28** 24], it is pointed out that in spite of the most thorough search, even in areas where every small pool was teeming with larvae, only 4 adults were found in dwellings. At the same time, 27 females were taken in dairy stables in the northern suburbs, and 11 out of 14 of them subjected to the precipitin test were positive for bovine blood, whereas none contained human blood ; 8 of these females were dissected and found to be free from malaria parasites. These findings are contrary to the usual observations in an area where *A. gambiae* occurs, and it is suggested that, when breeding under unusual climatic conditions, it may change its habit and become zoophilous. With the first cold weather, the species disappeared; it could not be found in May and June, and up to January 1940 it had not reappeared. It seems unlikely that it will do so until the exceptionally widespread breeding that took place over the Transvaal in 1937–38 is repeated.

Investigation of an outbreak of disease among farm labourers in the Transvaal resulted in the finding of numbers of the tick, *Ornithodorus moubata*, Murr., in the compound where the men were lying ill, and blood slides subsequently taken revealed the presence of spirochaetes. This is the first record of an outbreak of relapsing fever on the Transvaal highveldt.

A flea survey of the Union is in progress, and an analysis of the records shows that " wild " fleas have been taken on domestic rodents and " domestic " fleas on wild rodents ; moreover, some " wild " fleas were taken on a patient suffering from plague, so that the suspicion that they may transmit plague to man is confirmed beyond reasonable

doubt. *Protospirura muris*, in its adult stage an intestinal parasite of rodents, was recorded from *Xenopsylla eridos*, Roths., from the Orange Free State; hitherto this Nematode has been recorded from *X. cheopis*, Roths. It is probable that the flea becomes infected in the larval stage when feeding on nest débris contaminated with rodent faeces; rodents would then acquire infection by eating infected fleas. Larvae of *Hymenolepis nana* were found in *X. hirsuta*, Ing., and *X. brasiliensis*, Baker. Examples of *X. cheopis* fed on a guineapig infected with human louse-borne typhus failed to transmit the disease when subsequently fed on a guineapig or a rat. In an experiment in which batches of 50 very young larvae of *X. brasiliensis* were placed in sand, provided with food and reared at about 76·5°F. and relative humidities of about 33, 51, 65 and 73 per cent., the numbers of adults obtained were 0, 41, 44 and 43, respectively. The ability of this flea to complete its life-cycle at a relative humidity as low as 51 per cent. explains the fact that it commonly breeds in the débris on the floors of sheds, garages and huts, in which the humidity is much lower than in the nests of burrowing field rodents. A single experiment to determine whether the larvae could migrate to the moister depths if the surface of the soil was dried off showed that all died in the dry surface.

Beetles received from Bechuanaland, where they have been observed to cause painful blisters, have been identified as *Epicauta bisignata*, Mäkl. A further case of intestinal infestation with Coprids of the genus *Onthophagus* [*cf.* **26** 93] was reported during the year; the beetles had been passed by a native child.

Mazzotti (L.) & Osorio (M. T.). **Infección experimental por** *Trypanosoma cruzi* **en cuatro especies de triatomas.** [Experimental Infection with *T. cruzi* in Four Species of *Triatoma*.]—*Ciencia* **1** no. 3 pp. 113–114, 2 refs. Mexico, D.F., 1940.

The results are given of experiments in 1940 in which nymphs of four Mexican species of *Triatoma* (*picturata*, Usinger, *phyllosoma*, Burm., *barberi*, Usinger, and *pallidipennis*, Stål) became infected with *Trypanosoma cruzi* as a result of feeding on infected mice.

Johnson (C. G.). **Development, Hatching and Mortality of the Eggs of** *Cimex lectularius* **L. (Hemiptera) in relation to Climate, with Observations on the Effects of Preconditioning to Temperature.**—*Parasitology* **32** no. 2 pp. 127–173, 13 figs., 30 refs. London, 1940.

This study on the relations of eggs of *Cimex lectularius*, L., to climate is part of a wider investigation on the ecology of the bug. The lowest constant temperature at which complete development with hatching can occur (developmental-hatching threshold) is 13°C. (55·4°F.), but room temperatures in England are often between this and 0°C. (32°F.) for many months at a time. It is therefore important to study behaviour within this range, since high mortalities undoubtedly occur when it is prolonged. Recent evidence that the threshold for movements of *C. lectularius* depends on the temperature at which the bugs have been kept previously [*cf. R.A.E.*, B **28** 112] necessitated a consideration of possible effects of acclimatisation on the mortality and hatching of the eggs. Much of the detail described has been obtained incidentally to an attempt to discover the longest possible time an egg can survive and the lowest possible temperature at which

it can hatch. The techniques used in the experiments are briefly described.

The following is based on the author's summary: The period that elapses between a blood meal and oviposition affects the duration of the egg stage. Eggs laid soon after the meal take longer to hatch than those deposited later. Atmospheric humidity has no effect on the duration of the egg stage. Although the temperature-velocity graph (showing relation of temperature to the reciprocal of the duration of the egg stage) appears to be fairly linear between 18 and 30°C. (64·4 and 86°F.), the thermal constants (obtained by multiplying the developmental period by the temperature minus the developmental-hatching threshold of 13°C.) show considerable variation. A daily alternation of temperature with a range of 10°C. (18°F.), provided that the temperatures lie between the threshold and the optimum, results in an acceleration of development; this can, however, be accounted for by the fact that the temperature-velocity relationship is not linear, if the usual methods of thermal summation are used. Eggs were exposed to temperatures between 1 and 12°C. (33·8 and 53·6°F.) for different periods, and the times taken for them to hatch on subsequent incubation at 23°C. (73·4°F.) were compared with times taken to hatch by control eggs kept at 23°C. There is some evidence that a slight amount of development may occur at as low a temperature as 4°C. (39·2°F.), the times after exposure being shorter than times for control eggs. Thermal summation, however, suggests that exposure to temperatures between 13 and 11·7°C. (53·06°F.) result in a retardation of development, since the times after exposure at which hatching occurs at 23°C. are longer than would be expected. The method of thermal summation is criticised, mainly on the grounds that it assumes that a temperature has the same accelerating effect on all stages of embryonic development. A retardation such as that mentioned, may be either a true retardation or due to errors resulting from the assumption that the reciprocal of the time for complete development represents the true amount of daily development at all stages of embryonic growth.

Though the developmental threshold may be as low as 4°C., and the hatching threshold is at approximately 8°C. (46·4°F.), alternating temperatures such as occur in English houses are unlikely to affect the position of the developmental-hatching threshold at 13°C. Atmospheric humidity does, however, affect it, and relative humidities of 75–90 per cent. appear to be the only ones at which development with hatching can take place at a constant temperature of 13°C. Mortalities near this threshold appear to depend also on the temperature at which the eggs are laid (or perhaps on the temperatures at which they develop within the female). When incubated at 15°C. (59°F.) and 7 per cent. relative humidity, eggs laid at 15°C. suffered 97·1 per cent. mortality, whereas those laid at 23°C. suffered 32·9 per cent. If eggs laid at 23°C. are incubated at 15, 18 and 23°C. until nearly ready to hatch, the percentage hatch at temperatures near the hatching threshold is highest with those previously kept at 18°C. For hatching at 8°C., preliminary incubation at 15°C. is probably more favourable than at 23°C. Mortality of eggs laid at 23 and incubated at temperatures above 13°C. is only slightly affected by atmospheric humidity over the optimum range, but the effects are more noticeable near the upper and lower temperature limits. A higher mortality appears to be associated with a relative humidity

of 99–100 than with one of 90 per cent. The extreme temperature limits for eggs laid at 23°C. are 13 and 37°C. (98·6°F.). For eggs laid at 15°C., this range is restricted at both upper and lower limits. The temperature of oviposition, whether it is 15 or 23°C., seems to make no difference to mortalities between 18 and 28°C. (82·4°F.).

The mortalities of eggs exposed for varying periods to temperatures between 1 and 13°C. and various humidities are discussed. By means of probits [*cf.* A **22** 440 ; **23** 493] estimates of the times for 50 per cent. mortality (median exposure for death) and 99·99 per cent. mortality have been made for each of the temperature and humidity combinations. The median exposure for death is affected slightly by humidity at temperatures below 13°C., but no simple law relating survival to humidity was found either above or below this temperature. Variations in temperature between 0 and 34°C. (93·2°F.) are likely to influence survival more than the humidity variations possible within that range. At constant saturation deficiencies, the eggs survive longer at the higher temperatures between 1 and 13°C. ; the median exposure for death increases by 1·5–1·8 days for each rise of 1°C. [1·8°F.]. The scatter of mortalities about the median exposure as measured by the regression coefficient of probits on exposure times is slightly influenced by humidity, but is not affected by temperatures between 1 and 13°C. Much of the variation in the slopes of the mortality curves is thought to be due to inherent variations in the eggs themselves. With eggs laid at 23°C. and exposed to temperatures below 13°C., the longest exposure necessary to produce 99·99 per cent. mortality (as judged by subsequent incubation at 23°C.) was estimated at 79·8 days. This occurred at 12·1°C. [53·78°F.] and 73 per cent. relative humidity. The actual observed times of exposure for 100 per cent. mortality are somewhat shorter than the estimated times. Eggs with embryos in an advanced state of development are more quickly killed by exposure to 7·7°C. (45·86°F.) and 90 per cent. relative humidity than are newly laid eggs. Oviposition temperatures of 15, 18 and 23°C. produced no different effects on the mortality rates of eggs exposed to 10°C. (50°F.) and 90 per cent. relative humidity. Future problems and the ecological significance of the experimental results are discussed.

Dojmi (L.). **Pojave akutnog trovanja kao posljedica ujeda krpuše.** [Symptoms of Poisoning as the Result of a Bite of a Tick.]—*Glasn. tzentr. khig. Zavoda* **22** no. 4 pp. 400–403, 2 figs., 2 refs. Belgrade, 1939. (With a Summary in German.) [Recd. 1940.]

A case of acute but temporary poisoning in a man bitten by *Hyalomma savignyi*, Gerv. (*aegyptium*, auct.) is recorded from a village in Herzegovina. Brief notes on the tick are given from the literature ; it is a common pest of sheep in Herzegovina.

[Rastegaeva (E. F.) & Kolabskiĭ (N. A.).] **Растегаева (Е. Ф.) и Колабский (Н. А.). La durée de la conservation de** *Spirochaeta gallinarum* **dans les tiques** *Argas persicus* **et l'immunité contre la spirochétose des poules.** [*In Russian.*]—*Rev. Microbiol.* **17** (1938) no. 3–4 pp. 408–410, 13 refs. Saratov, 1940. (With a Summary in French.)

An account is given of investigations carried out in the laboratory at Leningrad to determine the length of time during which *Argas*

persicus, Oken, infected with *Spirochaeta anserina* (*gallinarum*) is capable of transmitting spirochaetosis to fowls [cf. *R.A.E.*, B **14** 170; **25** 130]. The ticks used in the tests had been taken in July 1929 from infected fowls in Pyatigorsk, North Caucasus [cf. **18** 103] and were kept at a temperature of 3°C. [37·4°F.] until February 1933, and thereafter mostly at room temperature, with intervals in an incubator at 22°C. [71·6°F.]. During the 8 years of the experiment, they were fed 11 times on fowls. Of the 9 birds that had no history of spirochaetosis, 7 developed the disease, the last in September 1937, one, which was subjected to feeding in 1934, showed no symptoms and is presumed to have been resistant, and in the case of the other, the ticks had engorged only one month previously and took no blood. The two birds that had previously suffered from spirochaetosis showed no symptoms after the feed. *A. persicus* was thus able to transmit the spirochaete 8 years after the infecting feed.

In tests on the persistence of immunity, 3 fowls that had developed spirochaetosis in 1934 showed no symptoms after being subjected to the feeding of infective ticks in 1935, or after the injection into them in December 1937 of blood containing numerous spirochaetes.

HOPKINS (G. H. E.) & CHORLEY (T. W.). **Experiments on the Destruction of Ticks.**—*E. Afr. med. J.* **17** no. 2 pp. 71–80. Nairobi, 1940.

Ornithodorus moubata, Murr., the vector of relapsing fever in East Africa, is prevalent in certain areas of Uganda, where it is especially abundant in temporary and semi-permanent buildings used by itinerant natives. It is often numerous in native gaols, where it causes concern to the authorities, since non-immune prisoners run the risk of contracting relapsing fever. The experiments described were undertaken with various fumigants and sprays to determine whether ticks could be economically controlled in such buildings.

The following is substantially the authors' summary: Fumigation, which was carried out with sulphur dioxide and hydrocyanic acid gas, was found to be completely ineffective under practical conditions, and the only spray that gave good results was a solution of paradichlorobenzene in kerosene (1½ lb. per gal.). This is considered to provide efficient control if the buildings are in good repair and the ticks are unable to shelter deep in thatch. In favourable circumstances one spraying may be sufficient. No effective means of eliminating ticks from dilapidated buildings has been found, and as the spray is moderately expensive, it is doubtful whether the employment of the large amount needed in such buildings would be financially justified even if the treatment were completely successful. It is essential in buildings of the semi-permanent type that all rooms should have ceilings with no holes to allow access to the interior of the roof. The same spray was found to be effective against the bed-bug, *Cimex hemiptera*, F., and cockroaches, but was not so satisfactory against mosquitos as the ordinary commercial sprays. It gave better results against ticks and bed-bugs when applied from a single coarse jet under considerable pressure than when atomised. Experiments showed that heat treatment in a Carnie disinfestor [*R.A.E.*, B **23** 245] provides a simple, cheap and efficient means of destroying ticks in the clothes and

bedding of new prisoners, which are the most common source of re-infestation of prison buildings, provided that the period of exposure is not less than half an hour.

Mail (G. A.). **The Paralysis Tick** *Dermacentor andersoni* **Stiles. Its Life-history and Control.**—*Publ. Canada Dep. Agric.* no. 692 (Circ. 161), 4 pp., 1 ref. Ottawa, 1940.

Much of the information contained in this brief account of the bionomics, economic importance and control of *Dermacentor andersoni*, Stiles, in Canada has already been noticed from other sources [*cf.* *R.A.E.*, B **25** 178, 179; **27** 172; **28** 143]. It is the most important of the 22 species of ticks that have been found in Canada because of its relation to disease (Rocky Mountain spotted fever in man and tularaemia and tick paralysis in both man and domestic animals); it is also the tick that most commonly attacks man in western North America. It is distributed throughout the dry belt of British Columbia, and in southern Alberta and south-western Saskatchewan; it does not occur on the coast of British Columbia or in eastern Canada. The measures recommended for the control of ticks on live-stock include dipping three times at intervals of 10 days, beginning when the ticks first appear in spring; an effective dip is composed of 24 lb. sodium carbonate, 8 lb. white arsenic, 1 gal. pine tar oil and 500 gals. water. Where a dipping vat is not available and there are only a few animals, dipping fluids may be applied by means of a sprayer. For cattle, a dressing consisting of about 3 parts of raw cottonseed oil or raw linseed oil, mixed with 1 part pine tar oil, applied from the back of the head, along the neck, over the peak of the shoulders and half way along the back, will usually kill most of the attached ticks, prevent reinfestation for some time and help to repel the attacks of blowflies. On horses, ticks often attach themselves under the jaw, on the belly and between the hind legs; it is sometimes advisable to clip the mane before a dressing is applied, since numbers of ticks are sometimes found hidden under the long hair. Whenever possible, stock should be confined in fenced, tick-free pastures during the period of tick activity in the spring months from the latter part of March to the end of June. A method of poisoning rodents on which the immature ticks feed, the symptoms and treatment of tick paralysis and the way in which ticks should be removed from man are described.

Rozeboom (L. E.), Stiles (G. W.) & Moe (L. H.). **Anaplasmosis Transmission by** *Dermacentor andersoni* **Stiles.**—*J. Parasit.* **26** no. 2 pp. 95–100, 15 refs. Lancaster, Pa., 1940.

Details are given of experiments carried out in an insect-proof barn in which *Anaplasma marginale* was transmitted to susceptible cattle by males of *Dermacentor andersoni*, Stiles, that had fed on infected cattle [*cf.* *R.A.E.*, B **26** 251], but not by any stage of the progeny of females that had so fed [*cf.* **26** 78; **27** 145]. The successful results were obtained with single males transferred to healthy animals two hours and one day, respectively, after the infecting feed, and with four males that had been kept on moist sand for 47 days after the infecting feed. The negative results were obtained when a batch of eggs and one batch of larvae were injected into susceptible cows, and when other batches of larvae, and nymphs and first-generation adults,

which had fed in the intervening stages on rabbits, were placed on susceptible cows.

Anaplasmosis was diagnosed in a herd of about 1,000 cattle in Wyoming on 28th June 1939. The first case had been noted at the end of May, and about 100 animals had developed the disease; mortality was estimated at 30–35 per cent. All cattle examined in this region were heavily infested with ticks, and about 200 adult ticks taken from horses and cattle all proved to be *D. andersoni*. The literature, which is briefly reviewed, suggests that larvae and nymphs of this species feed almost exclusively on small animals; if this is so, then stage-to-stage transmission would seldom take place. Moreover, the apparent reluctance of larvae to feed on large animals minimises the danger of the disease being spread by larvae derived from infected parent females. Since this species is a three-host tick that ordinarily takes only single meals in the larval, nymphal and adult-female stages, transmission by these stages would involve interrupted feedings [*cf.* **26** 251] and would perhaps be limited in nature to instances in which the original host dies and the tick is forced to re-attach on another animal in order to complete engorgement. The importance of the transmission by males lies in the fact that they may live for months and will feed many times. It is pointed out that although the transmission after an interval of two hours may have been an instance of mechanical transmission, the tick had been on the infected animal for 11 days and on the susceptible one for 5 days, so that there may have been time for a true biological cycle of the parasite to have taken place, in which case the incubation period in the tick is not more than 16 days.

HINMAN (E. H.) & HURLBUT (H. S.). **The Relation of Shade to** *Anopheles quadrimaculatus* **Breeding—A preliminary Report.**—*J. Parasit.* **26** no. 2 pp. 145–156, 3 figs., 4 refs. Lancaster, Pa., 1940.

After briefly reviewing the literature on the influence of shade on the breeding of different species of *Anopheles*, the authors describe investigations that are being carried out in the Tennessee Valley to determine whether it has any effect on *A. quadrimaculatus*, Say. Experimental plantings of bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa aquatica*) have been made in reservoirs of the Tennessee Valley Authority, but years must elapse before conclusions can be drawn from these. In addition, wooded areas comprising different species of trees were left uncleared below the high water contours in various reservoirs; the results of observations made in some of these areas in 1938 during June–August (the season when maximum shade occurs) are shown in a table, which gives such data as type of vegetation, light readings, temperature, pH and the numbers of larvae of *A. quadrimaculatus*, *A. punctipennis*, Say, and *A. crucians*, Wied., that were collected. Observations were made in a number of other stations in 1937 and 1938, but for various reasons the results are not given in this report. The findings, however, agree with those shown in the table.

The areas selected for study were those providing the densest shade, and larvae of *A. quadrimaculatus* were found in all of them. Considerable ranges of light intensity existed within the individual areas, and the

distribution of the larvae in any given shaded area showed no correlation with light intensity. The table includes data on two unshaded areas and on two that were considered to be intermediate between dense shade and absence of shade; *A. quadrimaculatus* bred in all of them. *A. punctipennis* was relatively scarce or absent, except in one area, where it was the most abundant Anopheline; in this area the shade was rather dense and the water temperature gave the lowest average encountered during June–August. With one exception, *A. crucians* was found in all the shade stations containing *A. quadrimaculatus*. It was rarely taken in areas where the water was unshaded, but it was the predominant species in certain of the shade stations; in the latter the pH was always below 6·7. Routine observations in most of the stations shown in the table were continued during the summer of 1939. The findings were similar to those already obtained, except that *A. punctipennis* was present in two shaded areas in which it had not previously been taken.

To obtain information on the relative attractiveness or repellent effect of dense shade, a tarpaulin was suspended over an area in which *A. quadrimaculatus* was breeding in moderate abundance; larvae were prevented from drifting into or out of the area by a barrier. The results indicated that this species continues to oviposit in relatively dense shade (averaging 7·7 foot-candles), that the eggs hatch and that the larvae develop normally. However, the intensity of breeding diminished during the 6 weeks of the experiment, the number of larvae per 20 dips varying from 59 to 19 before the tarpaulin was erected and from 16 to 2 subsequently. It has always been assumed that oviposition usually occurs at night, so that shade in itself would have little effect in determining the selection of sites for it, but the development of larvae in the area would seem to indicate that none of the elements essential for normal growth was lacking. The success of an experiment in which *A. quadrimaculatus* was reared through its entire life-cycle in an incubator room at 20°C. [68°F.] in the entire absence of light indicates that light in itself is not essential for its complete development.

Rozeboom (L. E.). *Flebotomus suis*, **a new** *Flebotomus* **from Panama (Diptera : Psychodidae).**—*Amer. J. Hyg.* **32** no. 1 Sec. C pp. 8–11, 5 figs., 2 refs. Lancaster, Pa., 1940.

The author describes the adults of both sexes of *Phlebotomus suis*, sp. n., from material taken on the walls of a pigsty near a village in the Republic of Panama in August 1937. He states, however, that this species may prove to be *P. gomezi*, Nitzu., which was described from Venezuela from the female only [*R.A.E.*, B **19** 183].

Crowell (R. L.). **Insectary Rearing of** *Anopheles quadrimaculatus*. **(A preliminary Report).**—*Amer. J. Hyg.* **32** no. 1 Sec. C pp. 12–20, 3 figs., 8 refs. Lancaster, Pa., 1940.

The rearing of *Anopheles quadrimaculatus*, Say, was begun at Wilson Dam, Alabama, in November 1937, using eggs of a strain that had been reared in captivity in Florida for about 63 lineal generations. Various disadvantages of the technique used in Florida [*cf. R.A.E.*, B **23** 283] became apparent in the first 8 months during which it was strictly followed, and as a result of studies begun in the summer of

1938, a simplified technique was developed and has given very satisfactory results. The management of the insectary, which previously required the full time of an attendant, can now be performed easily in two hours a day. Dog biscuits pulverised by rubbing them on sand paper in a small mill have been substituted for the hay and wheat infusions previously used as food for the larvae, so that most of the time and labour necessary to prepare the infusions is saved. It is estimated that 1 lb. dog biscuit would be sufficient to rear about 29,000 larvae. About 400 eggs are placed within a small ring of waxed paper or cork on the surface of the tap water that half fills each shallow enamel pan (20 by 12 by 2 inches) used for rearing the larvae. When about 75 per cent. of the eggs have hatched, small amounts of the powdered biscuit are sprinkled on the water from a salt shaker. Since the decomposition of excessive amounts of food is accompanied by the formation of a zoogleal scum, which tends to immobilise and eventually kill the larvae, the addition of further food is delayed until nearly all that previously supplied has been consumed or has sunk to the bottom of the pan. If overcrowding is avoided, it is normally unnecessary to manipulate the larvae at all. Pupae are removed with a wide-mouth medicine dropper and placed in a bowl (5 inches in diameter) covered with a cylindrical cage into which the adults emerge. Pieces of cork on the water facilitate emergence.

Since it has been found that a self-perpetuating colony of this strain can be established in a cage [**23** 284], the stock adults are now kept in a cage with sides about 40 inches square, instead of in the room originally used. When emergence from a given lot of pupae is practically complete, the bowl and emergence cage are placed in the stock cage and the cover of the emergence cage removed, so that the adults enter the stock cage without manipulation. Approximately equal numbers of males and females are introduced into the colony. Dead mosquitos are removed twice weekly. The females are given an opportunity to feed each day on the shorn back and sides of a large rabbit that is partly immobilised on a board and introduced into the cage for 1–2 hours in the early morning or late afternoon. Since July 1938, a single rabbit has provided the sole source of blood for a colony averaging 3,500 mosquitos and does not appear to suffer any ill effects from the daily feeding of more than 100 mosquitos. The substitution of rabbit blood for blood of the laboratory assistant was accomplished with little difficulty. Moistened dried peaches, prunes and raisins and 10 per cent. dextrose solution supplied on a wick are always provided for the stock colony. On alternate evenings, the females are given the opportunity of ovipositing on a funnel of filter paper placed in a bowl of tap water or on the surface of the water within the funnel. The eggs are collected by piercing a small hole in the point of the cone, so that when the cone is lifted the eggs are left stranded on its sides. They are then washed gently from the filter paper and placed in pans to hatch, or are left on the paper in a large dish and stored in a refrigerator at 10°C. [50°F.], where they will remain viable for several weeks, provided that the filter paper is kept moist.

The dilution of the infusion for the young instars and its enrichment for the older ones is unnecessary, because the youngest larvae feed almost entirely on dog biscuit, and additional food for the older ones is provided by the ciliates that appear in the pans. The bacterial and protozoal populations develop slowly at first and tend to increase

directly with the increase in the size of the larvae. Of 200 larvae examined from the first instar with special reference to mortality, all reached the fourth instar and 197 pupated; 196 vigorous adults emerged. Between 21st October 1938 and 13th January 1939, 26,212 adults were reared from 28,076 pupae, representing a mortality rate of only 7 per cent. The size of the adults is large compared with the measurements given in the literature.

DA FONSECA (F.) & DA SILVA RAMOS (A.). **Novo subgenero e novas especies de Anofelinas neotrópicas (Diptera. Culicidae). (Nota previa).**—*Mem. Inst. Butantan* **13** (1939) pp. 383–387, 2 pls. S. Paulo, 1940. (With a Summary in English.)

An examination of specimens in a collection in Brazil showed that the terminalia of two male Anophelines taken in the State of São Paulo and labelled *Anopheles* (*Arribalzagia*) *mediopunctatus*, Theo., differed from those of this species as described by Bonne [*R.A.E.*, B **12** 25]. They are here described as *A. limai* and *A. costai*, spp. n. Since the description of the female of *A. mediopunctatus* from Dutch Guiana included by Bonne & Bonne-Wepster in a work already noticed [**14** 59] differs from the original description of Theobald, the name *A. bonnei*, sp. n., is proposed for the Anopheline from Dutch Guiana. A key, based on the coloration of the hind tarsi and palps, is given to the adults of the four Anophelines dealt with, and the subgenus *Shannoniella*, n., is erected for them, with *A. limai* as the type.

KUMM (H. W.), KOMP (W. H. W.) & RUIZ (H.). **The Mosquitoes of Costa Rica.**—*Amer. J. trop. Med.* **20** no. 3 pp. 385–422, 1 map, 7 refs. Baltimore, Md., 1940.

Details are given of a mosquito survey of Costa Rica carried out as part of a recent malaria survey [*R.A.E.*, B **28** 44]. The data are based on the 24,704 mosquitos (14,961 adults and 9,743 larvae) taken in the first 1,000 collections, which were made between December 1937 and July 1939. The 93 species included 16 Anophelines, all of which have already been recorded [*loc. cit.*], except *Anopheles albitarsis*, Arrib. While knowledge of the Anophelines is probably reasonably complete, most of the collections of other mosquitos were made incidentally, and it is known that many more species occur than were encountered by the authors.

A. albimanus, Wied., constituted 89·7 per cent. of the first 9,000 Anophelines collected as adults, *A. pseudopunctipennis*, Theo., the next most numerous, constituting only 3·1 per cent. Moreover, the former also constituted 96·4 per cent. of the adults taken in houses and 93·3 per cent. of those taken in mosquito traps of the stable type, but only slightly more than half of the 906 Anophelines caught with a horse or mule as bait at sunset. Among the 7,548 Anophelines collected as larvae, *A. albimanus* constituted 38·9 per cent., the only other species forming any considerable proportion of the collections being *A. pseudopunctipennis* (27·6 per cent.) and *A. argyritarsis*, R.-D. (21·2 per cent.). Since *A. argyritarsis* constituted only 0·4 per cent. of the adults, it evidently feeds but rarely on domestic animals or man and cannot be important as a vector of any human disease in Costa Rica.

Analysis of the breeding places of these three commoner species showed that at least two-thirds of the larval collections of *A. albimanus*, about half those of *A. argyritarsis* and just over 40 per cent. of those of *A. pseudopunctipennis* were obtained from ground pools, ditches or borrow pits ; the breeding places next preferred by all three species were the hoof-prints of cattle and pools in stream beds, 28 per cent. of *A. pseudopunctipennis* being found in the latter. These three species, together with *A. neomaculipalpus*, Curry, formed a group that consistently chose breeding places well exposed to sunlight. The relative prevalence of 5,338 non-Anophelines caught inside houses, in stable-type traps or with a horse as bait at sunset are shown in a table ; the most common in houses was *Culex fatigans*, Wied. In view of the proximity of Costa Rica to some of the endemic regions of yellow fever, catches of adult mosquitos were occasionally made in the dense forest in the daytime, using human bait. A list giving the numbers of the 472 mosquitos caught in this way shows that the most prevalent were certain wild species of *Aëdes* and *Psorophora*.

Lists of the localities and provinces in which each species of mosquito was found, together with notes on the preferred type of breeding place, are followed by keys to the five tribes recognised by Dyar, the genera of the tribes ANOPHELINI and CULICINI, and the species (adult females) of *Psorophora*, *Aëdes* (including a new species), *Orthopodomyia*, *Mansonia*, *Uranotaenia* and *Anopheles*. A list is also given of 15 other blood-sucking Arthropods collected in the course of the survey.

BOYD (M. F.) & JOBBINS (D. M.). **Further Observations on the Comparative Susceptibility of Nearctic and Neotropical Anophelines to Coindigenous Strains of** *Plasmodium falciparum*.—*Amer. J. trop. Med.* **20** no. 3 pp. 423–429, 5 refs. Baltimore, Md., 1940.

Experiments in Florida on the comparative susceptibility of a local strain of *Anopheles quadrimaculatus*, Say, and a strain of *A. albimanus*, Wied., reared from eggs received from Panama, to infection with three strains of *Plasmodium falciparum*, proved by cross-immunity experiments to be distinct, showed that the latter is significantly less susceptible to the strains of *P. falciparum* from Florida and Mexico, whereas there is no significant difference in the susceptibility of the two Anophelines to the strain presumed, from the history of the case from which it was derived, to have come from Panama. Thus, the results are essentially similar to those of previous experiments [*cf.* *R.A.E.*, B **26** 143].

HINMAN (E. H.) & HURLBUT (H. S.). **A Study of the Winter Activities and Hibernation of** *Anopheles quadrimaculatus* **in the Tennessee Valley.**—*Amer. J. trop. Med.* **20** no. 3 pp. 431–446, 2 figs., 10 refs. Baltimore, Md., 1940.

After briefly reviewing the literature on the overwintering habits of various species of Anophelines in the southern United States, the authors give the results of observations on *Anopheles quadrimaculatus*, Say, in the Tennessee Valley, made at irregular intervals during the winters of 1936–37 and 1937–38 and of a more intensive study throughout the entire hibernation period in 1938–39.

The following is based on the authors' summary : *A. quadrimaculatus* probably passes the winter in this latitude chiefly as inseminated adult females. No evidence of the survival of the immature stages has been discovered. A fat reserve is accumulated in the autumn, which gradually diminishes during the winter. Hibernating females in caves may survive as long as 69 days without food. The number of individuals in hibernating places reaches its maximum during the latter part of November. A renewal of reproductive activity occurs early in February. Autumn reared specimens survived the winter in a small outdoor cage. Under artificial conditions during October, no evidence of gonotrophic dissociation was observed. The data regarding this phenomenon with reference to *A. quadrimaculatus* are not sufficient to warrant any conclusions. During November and December, ovarian development appears to be deterred at temperatures below 59°F. and stimulated at temperatures of 68°F. and above. Intermediate temperatures have not been explored. The temperature ranged from 51·5° to 59°F. between 16th December and 27th January in one cave where a continuous record was kept. Oöcysts were discovered on the stomach of one specimen found in a cave on 1st December.

KINGSBURY (A. N.). **Annual Report of the Malaria Advisory Board (F.M.S.) for the Year 1939.**—Med. 8vo, 22 pp., 2 pls. Kuala Lumpur, 1940.

The work accomplished and the information obtained in 1939 in various investigations connected with malaria and its control in Malaya are briefly reviewed [*cf.* also *R.A.E.*, B **28** 188]. The incidence of malaria was again high, and much of the increase in the past three years appears to have resulted from the methods used in the replanting of rubber [*cf.* **28** 63, 84]. The total area replanted in 1939 was about twice as large as in 1938, and since a small part of the acreage on many estates has been replanted, the places where Anophelines may breed in excessive numbers, unless thorough control is undertaken, are widely distributed. Instances are given showing the importance, in certain circumstances connected with replanting, of extending control measures on estates beyond the usual distance of half a mile [*cf.* **27** 210]. Rubber oil distilled from scrap rubber has been used exclusively as the larvicide on one estate since September 1938. *Anopheles maculatus*, Theo., has not been found during larval surveys in the controlled area, spleen rates in both children and adults have decreased slightly and the number of cases of fever has not been above normal. The use of such oil may be economic on estates in places where there is little sale for scrap rubber or in an emergency when supplies of anti-malarial oil are difficult to obtain. An experiment in which drains in a ravine were brushed regularly each week, in the same manner as in the " spray-brush " oiling method [**22** 148] but without any oil, gave somewhat inconclusive results, but indicated that the brushing controlled the breeding of *A. maculatus* to a minor extent.

In a report on the prevention of erosion in concrete anti-malarial drains [*cf.* **24** 260], it was stated that continued observations had confirmed the view that the only effective methods were either to render drains with an aluminous cement that hardens rapidly and produces a very hard material, or to set glazed tile channels into the

bottom of the inverts. These latter have been entirely satisfactory and should be absolutely permanent. The glazed channels carry the dry-weather flow of water, and when, owing to rain, the water rises above the channel, the carbonic acid is so diluted by the greater volume of water that it does not erode the cement. Mining ballast is now used for aggregate in making the inverts, as this is resistant to the action of acid water.

With a view to shedding light on the question of the durability of timber used in fascine drainage [*cf.* **22** 149], the terminal portion of a drain that had been packed nearly six years previously with medium-sized branches of rubber (2–3 inches in diameter) and covered with lallang grass and earth was dug up ; the state of preservation of both the wood and the lallang was found to be excellent. The drain concerned had always contained flowing water or had been at least moist. It was reported that timber used in drains with only a seasonal flow of water also appeared to be lasting well, since a number of such drains were still functioning perfectly after 3 years. The only difficulty likely to be encountered in using this method is that the drains may become choked. Bends, particularly right-angle bends, should be avoided, and, if the soil is sandy, the drains should be almost straight and bamboos should be used for preference. On one estate of 4,000 acres, the monthly consumption of anti-malarial oil was reduced from 800 to 400 gallons and the spleen rate was halved by using fascine drains, and it was expected that these figures would be further reduced by the end of 1940. Moreover, erosion and the loss of trees on the banks of open drains are avoided by this method.

PIERCE (W. D.). **The Black Widow Spider and its Parasites.**—*Bull. S. Calif. Acad. Sci.* **37** pt. 3 pp. 101–104, 3 figs. Los Angeles, Calif., 1939. [Recd. 1940.]

During an examination of the fauna of the sand dunes of Los Angeles County, California, made in August 1938, the Chloropid, *Pseudogaurax signatus*, Lw. [*cf. R.A.E.*, B **25** 209] and a Scelionid here described from both sexes as *Baeus californicus*, sp. n., were found to be parasitic in egg sacs of *Latrodectus mactans*, F., which were numerous in clumps of *Opuntia*. *L. mactans* has recently attracted much attention in California because of its increasing abundance and the numerous cases of severe and often fatal bites [*cf.* **23** 212]. Of the egg sacs found, nine had been parasitised by *B. californicus*, and two by *P. signatus*, while 26 were not parasitised. *P. signatus* oviposits on the outside of the egg sac, and the larvae apparently destroy less than 50 per cent. of the eggs in it. *B. californicus* oviposits in the eggs [*cf.* next abstract], and the percentage parasitised by it in eight sacs examined ranged from 93·54 in one to 100 in four, the total number of spider eggs per sac being 207–408. The adults lived for 10–14 days without food. The proportion of females to males was about 10 : 1.

PEMBERTON (C. E.) & ROSA (J. S.). **Notes on the Life History of** *Baeus californicus* **Pierce, an Egg Parasite of the Black Widow Spider.**—*Hawaii. Plant. Rec.* **44** no. 2 pp. 73–80, 4 figs. Honolulu, 1940.

Details are given of the bionomics of the Scelionid, *Baeus californicus*, Pierce, an egg parasite of *Latrodectus mactans*, F., recently described

from California [see preceding abstract] and introduced into Hawaii in August 1939 [*cf*. *R.A.E.*, B **28** 173] for the control of this spider, which is believed to have been responsible for a number of the cases of illness following the bites of " something not actually seen " that have occurred in localities where it is known to be present. The account is based on data obtained when rearing over 32,000 parasites between September 1939 and April 1940, by which time about 32,500 had been distributed in various parts of the Territory. The parasite is apparently completely specific and showed no interest in eggs other than those of *L. mactans* ; attempts to rear it on the eggs of *L. geometricus*, Koch, which was found on Oahu in 1939, were unsuccessful. The wingless female is quite active and when disturbed may jump 50 or more times its own length, which is about 0·03 inch. The egg sacs of the spider, which contain 200–400 eggs, are suspended in thin threads of web under stones, boards or piles of rubbish, beneath buildings, in tree stumps near the ground, and sometimes in clumps of grass or weeds and other protected places, but, by crawling and jumping, the parasite apparently has no difficulty in finding and reaching them, and its smooth compact body enables it to move easily among the threads of the web.

Egg sacs more than 3 days old are not attacked. After a preliminary examination of the sac, which may last more than 24 hours, the female bores its way in and may begin immediately to deposit a single egg into each spider's egg. The process of laying an egg usually lasts 2–9 minutes. Sometimes the exhausted female emerges from the sac a few days after completing oviposition, but many die inside. Females were kept alive for as long as 20 days if honey and water were supplied and they were given no opportunity to oviposit. When more than one female enters an egg sac, more than one egg may be deposited and hatch in an egg of the host, but only one parasite develops to maturity. At temperatures prevailing at Honolulu during January 1940, the egg, larval and pupal stages last about 3, 13 and 10 days. The females contain more than 200 mature eggs when they emerge from the eggs of the host. They greatly outnumber the males, which emerge at about the same time or a little earlier, but as pairing lasts only a moment, all of them may be fertilised before they escape from the egg sac. Though the males are winged, many die in the egg sac, and pairing outside it is exceptional. Most of the females emerge from the egg sac on the second day and are ready to begin parasitising spider eggs immediately. If they are unfertilised, all the progeny will be males ; if they are fertilised, most of the progeny will be females. Young spiders hatched from any unparasitised eggs about 13 days before the parasites emerged. The appearance of the eggs and larvae of the parasite and of the parasitised and unparasitised eggs of the spider is described. The complete life-cycle of *B. californicus* averaged 22 days during the warm months of the year and from 25 to 29 during the winter. There is, however, a considerable amount of delayed emergence ; for example, parasites from an egg sac exposed to attack on 6th November emerged almost daily between 30th November and 12th January, although most of them emerged during the first 8 days. The first record of the establishment of the parasite in the field was obtained in December 1939, when an egg sac that produced 348 parasites and no spiders was collected on Oahu in a locality where the parasite had previously been liberated.

SCHUHARDT (V. T.). **A " Ticktorium " for the Propagation of a Colony of infected** *Ornithodorus turicata*.—*J. Parasit.* **26** no. 3 pp. 201–206, 4 figs., 8 refs. Lancaster, Pa, 1940.

For many years, the cave in central Texas in which were found examples of *Ornithodorus turicata*, Dugès, that were shown to be vectors of relapsing fever in man [*R.A.E.*, B **19** 116] had served as a source of infected ticks and spirochaetes for experimental purposes. In 1936, it became obvious that it would be inundated by the newly created Buchanan Lake on the Colorado River. Consequently, a final collection of several hundred ticks was made at the cave in October 1936, and at the same time about 2 U.S. gals. of the powdery limestone dust, into which the ticks burrow, was obtained from it.

It was decided to keep the ticks in a miniature cave or " ticktorium " constructed in a way that would permit the making of certain ecological studies and the maintenance of the colony in the conditions of safety rendered necessary by the high infectivity to man of the spirochaetes harboured by the ticks. This cave has been in use for three years. It is in a block of limestone, $14 \times 12 \times 9\frac{1}{2}$ ins., resting on a layer of board 2 ins. thick, which covers a layer of sand $1\frac{1}{2}$ ins. thick in the bottom of the galvanised iron box that forms the framework of the structure. A tongue across the rear of the limestone block extends down to make contact with the sand. The floor of the cavern and the area in front and to the sides of the limestone block are covered with a layer, 2–3 ins. thick, of the limestone dust, which is held in place by a strip fixed about 3 ins. in front of the block. A hole in the floor board in front of this strip allows of water being poured into the sand below. It was assumed that the water would pass into the tongue of the limestone block and aid in maintaining a suitable humidity in the cavern. A trough round the inside of the box near the top is kept partly filled with a mixture of oil and vaseline to catch ticks attempting to escape from the cage. As additional safeguards, there is a lid of wire gauze to exclude flying insects that might carry off larvae and nymphs, and the box is set in a shallow pan partly filled with crankcase oil. About 100 nymphs and adults were placed in the cave on 20th November 1936, and the population now numbers several thousand, in addition to thousands that have been caught in the trough. There is no evidence that any have ever passed this trap. The colony has been maintained at room temperature, which has ranged from about 60°F. in winter to about 102°F. in summer.

The ticks have been fed exclusively on white rats at intervals of 1–7 months. The rat is placed in front of the cavern in a cylinder of $\frac{1}{2}$ in. mesh hardware cloth closed at each end with a rubber stopper. Great care is necessary to prevent the escape of ticks when the rat is removed. Therefore, after the desired feeding interval, the cylinder containing the rat is suspended to a crossbar resting on the inner sides of the trough of oil, and left for several hours, during which time most of the remaining ticks complete their feed and fall to the ground. As a further precaution, the rat (if alive) is then transferred to a tall glass cylinder with a lid and false bottom of hardware cloth. The top of the inside of the cylinder is smeared with oil and vaseline and the cylinder set on a pan with an oil trap surrounding it. The rat is left in the cylinder for at least 10 days and then dipped in an oil bath. If the rat has been killed during the feeding of the ticks, it is transferred

to a pail with a tight lid and autoclaved. Work involving the handling of infected rats or ticks is done over a galvanised iron pan surrounded by an oil-filled trough.

BURNET (F. M.) & FREEMAN (M.). **Note on a Series of Laboratory Infections with the Rickettsia of " Q " Fever.**—*Med. J. Aust.* 1939 **1** p. 11 (repr. 2 pp.). Sydney, 1939. [Recd. 1940.]

In a laboratory in Victoria where work was being carried out on Q fever [a disease that has been observed of recent years in Queensland, chiefly in abattoir workers and dairy farmers, and is attributed to a rickettsia that fails to produce agglutinins for any of the Proteus X group of bacteria], mild or subclinical infections with the disease occurred in 1937 among persons who had been taking part in the experiments or working on the floor on which they were being carried out and the inoculated mice were kept. The infections were recognised by serological tests (rickettsial agglutination and protection tests in mice). Since two of the infected persons had never worked with the organism, transmission by a freely moving Arthropod vector was suspected. Two ectoparasites had been observed on the stock of mice that were used as laboratory animals in practically all the work and that must have been the origin of the infections in man. These were the louse, *Polyplax serrata*, Burm., a few of which were almost always present, and a blood-sucking mite, *Liponyssus bacoti*, Hirst, which appeared at times in large numbers, though at others the stock seemed to be free from it. It is thought that this mite, which is known to bite man, was probably the vector, but no experimental evidence of its capacity to transmit the infection was obtained.

SMITH (D. J. W.), BROWN (H. E.) & DERRICK (E. H.). **A further Series of Laboratory Infections with the Rickettsia of " Q " Fever.**—*Med. J. Aust.* 1939 **1** p. 13 (repr. 2 pp.). Sydney, 1939. [Recd. 1940.]

Descriptions are given of two cases of laboratory infection with Q fever that occurred in man in June 1937 and July 1938, respectively, in Queensland. In both cases, the diagnosis was confirmed by inoculation of blood into guineapigs and by the presence of Q agglutinins in the serum during convalescence. Both cases were associated with work on mice, though these animals were little used, nearly all the work, which had been in progress since September 1935, having been carried out with guineapigs. Suspensions of lice (*Gliricola porcelli*, L., and *Gyropus ovalis*, Nitzsch) from infected guineapigs were inoculated into other guineapigs without producing infection. At times, the mice were found to be infested with *Liponyssus bursa*, Berl., a blood-sucking mite that attacks man. However, both infections occurred during the winter, when no mite could be seen, and attempts made during March 1938 to infect guineapigs experimentally through the agency of the mites failed to produce any conclusive evidence that transmission had been accomplished. It is thought that in both cases the rickettsia entered through the skin, perhaps through a minute abrasion, owing to contact with infective mouse tissue.

DERRICK (E. H.). *Rickettsia burneti*: **the Cause of "Q" Fever.**—*Med. J. Aust.* 1939 **1** p. 14 (repr. 1 p.). Sydney, 1939. [Recd. 1940.]

Rickettsia burneti, sp. n., the causal organism of Q fever, is briefly described, and lists are given of papers in which it is more fully described and illustrated and its aetiological relationship to Q fever discussed and of publications containing a general account of the disease.

DERRICK (E. H.), SMITH (D. J. W.), BROWN (H. E.) & FREEMAN (M.). **The Role of the Bandicoot in the Epidemiology of "Q" Fever: A Preliminary Study.**—*Med. J. Aust.* 1939 **1** p. 150 (repr. 6 pp.), 5 figs., 2 refs. Sydney, 1939. [Recd. 1940.]

Bandicoots are common animals of the Australian bush and were therefore examined at an early stage in the search for a possible reservoir of Q fever. This report is based on a study of 50, all of the species *Isoodon torosus*, caught in Queensland on the mainland or on Moreton Island. At least 5 out of 9 bandicoots inoculated with Q fever material became infected, but the infection was inapparent, the only abnormality being the enlargement of the spleen. Serum agglutinins against Q rickettsiae developed in 2 inoculated animals. Of 44 uninoculated bandicoots tested for Q agglutination, 4 reacted, including 2 out of 5 taken at Cowen Cowen on Moreton Island. Bandicoot sera that reacted to agglutination tests were also capable of protecting mice and guineapigs against infection. Injection into guineapigs of suspensions of large numbers of lice, fleas, ticks and mites taken on bandicoots failed to produce Q fever at the first or second passage.

Studies in the Epidemiology of Q Fever.

SMITH (D. J. W.) & DERRICK (E. H.). **1. The Isolation of Six Strains of** *Rickettsia burneti* **from the Tick** *Haemaphysalis humerosa*.—*Aust. J. exp. Biol. med. Sci.* **18** pt. 1 pp. 1–8, 3 figs., 5 refs. Adelaide, 1940.

DERRICK (E. H.) & SMITH (D. J. W.). **2. The Isolation of three Strains of** *Rickettsia burneti* **from the Bandicoot** *Isoodon torosus*.—*T.c.* pt. 2 pp. 99–102, 1 fig., 1 ref.

SMITH (D. J. W.). **3. The Transmission of Q Fever by the Tick** *Haemaphysalis humerosa*.—*T.c.* pt. 2 pp. 103–118, 2 figs., 7 refs.

——. **4. The Failure to transmit Q Fever with the Cat-flea** *Ctenocephalides felis*.—*T.c.* pt. 2 pp. 119–123, 5 refs.

In the first paper, an account is given of the isolation, in September 1938 and March 1939, of six strains of *Rickettsia burneti* from *Haemaphysalis humerosa*, Warb. & Nutt., a common ectoparasite of the bandicoot, *Isoodon torosus* [*cf.* preceding abstract]. The search for an Arthropod vector began in July 1937, and between November 1937 and March 1939, suspensions of 439 examples of *H. humerosa* from bandicoots collected on Moreton Island and 63 from bandicoots from the mainland were inoculated into guineapigs. The six strains of *R. burneti* were all from ticks taken on bandicoots caught on Moreton Island. Four strains were isolated from male ticks, one from nymphs and one from an inoculum containing both males and females. In

three cases, the primary inoculum produced a febrile reaction, while in the others infection became apparent only after passage into a second animal. The sera of all the bandicoots on which the infected ticks were found agglutinated *R. burneti*, and from one, a strain of virus was obtained by guineapig inoculation of liver, spleen and kidney.

H. humerosa has been recorded from a variety of animals along the eastern and northern seaboards of Australia. Bandicoots and oppossums appear to be its most common hosts, and others include rats and cattle. It is thought to play an important part in maintaining the causal agent of Q fever in the native animal population, but its relation to human infection has not been determined, as it has not been observed to bite man in nature, though it has done so under experimental conditions, and a history of tick-bite has not been a feature of infection. Over 150 inoculations of other ectoparasites from a wide range of native and domestic animals within the endemic area gave entirely negative results.

In the second paper, the finding of infection in 1 out of 60 bandicoots (*I. torosus*) captured on the mainland of Queensland and 2 out of 43 captured on Moreton Island is reported. Guineapigs inoculated with suspensions of 70 nymphs of *Ixodes holocyclus*, Neum., and 11 fleas of the genus *Pygiopsylla*, all from the infected bandicoot from the mainland, did not become infected. The other infected bandicoots both harboured *H. humerosa*. Those from one of them were infected and were the source of one of the strains mentioned in the previous paper.

A detailed account is given in the third paper of experiments on the transmission of Q fever by *Haemaphysalis humerosa*. The technique used in feeding the ticks upon the host animals is described. Larvae, nymphs and adults bred from females taken on bandicoots were successfully infected by feeding them on infected guineapigs in the febrile stage. Rather more than half the ticks were definitely proved to have become infected. The parent ticks were examined, but none of them was found to be infected. The virus was proved to be present in nymphs developing from larvae that had fed on infected guineapigs, and in adults developing from larvae or nymphs that had so fed, by the demonstration of rickettsiae in stained smears and sections of their tissues and by the production of infection in guineapigs into which they were inoculated or upon which they were fed. There was no significant difference between the numbers of adults found to have retained infection after one and two metamorphoses. This suggests that the finding of only a moderate total percentage of infection was due to the failure of immature ticks to become infected and not to loss of infection during development. Infected nymphal and adult ticks infected 5 out of 18 guineapigs on which they were fed. The progeny of 16 female ticks that had been exposed to infection as nymphs or adults were examined for evidence of transovarial passage of the virus. Of these females, eight appeared not to have been infected, and the results of examination of their progeny were entirely negative. The progeny of one individual infected in the nymphal stage out of the remaining eight, in which the virus could be detected after the completion of oviposition, gave evidence of hereditary transmission, a guineapig on which 15 young larvae were fed becoming infected, and numerous rickettsiae being found in smears of a single nymph examined 20 days after metamorphosis. Negative results with other ticks of the same batch suggest that the rickettsiae may be transferred through only a

percentage of the ova to the succeeding generation, and the finding of evidence of transmission among the progeny of only one of eight ticks known to be infected suggests that hereditary transmission occurs only occasionally.

In order to study the organism and its distribution within the tick, serial sections were prepared of a number of adults and nymphs that had fed on infected guineapigs during an earlier stage. The rickettsiae could not be detected in some of the ticks, but in the others they were abundant in the intestinal epithelial cells and the lumen of the gut. The invasion of other organs was never observed. The cell infection pattern of *R. burneti* in the tick was found to be of the typhus type [*R.A.E.*, B **24** 154]. Rickettsiae were never seen in the intestine anterior to the mid-gut. In the hind-gut, they were found only as single bodies scattered amongst the crystalline contents of its lumen.

Guineapigs into which suspensions of infected ticks were inoculated usually reacted with fever after a short incubation period, indicating a high degree of infectivity. To determine whether certain cases of human infection might be attributed to contamination of the skin with crushed infected ticks, an attempt was made to infect guineapigs in this manner. An emulsion of an engorged female tick was applied on six guineapigs to prepared areas of the flank from which the hair had been clipped. The areas were free from scratches and abrasions. All the animals became infected, the infection being inapparent and becoming obvious on passage. Samples of faeces from five batches of infected adult ticks, four of which had acquired infection during the nymphal and one during the larval stage, were inoculated separately into guineapigs, producing infection in each instance. The faeces were collected at intervals ranging from 4 to 19 days after the ticks began to engorge on normal guineapigs. Faeces collected from another batch of adult ticks, not previously exposed to infection, during the tenth day of their engorgement upon an infected guineapig also proved infective, producing an inapparent infection. Faeces of infected ticks were also applied to the guineapigs on abraded or unabraded skin. All the six guineapigs with unabraded skin and five of the six with abraded skin became infected, infection being inapparent in the first group and apparent in the second.

The fourth paper contains an account of experiments with *Ctenocephalides felis*, Bch., which readily attacks man and is common on dogs, cats and calves in the country districts in which Q fever is endemic. Dogs are known to be susceptible to the disease. Calves and dairy cows entering the Brisbane abbattoir, where Q fever is classed as an occupational disease, are sometimes infested with *C. felis*, and men engaged in removing the hides are attacked by it. The experiments showed, however, that *Rickettsia burneti* was incapable of survival or multiplication within the body of this flea, which can therefore be eliminated as a factor in the production of animal and human infections.

Dyer (R. E.). **Similarity of Australian " Q " Fever and a Disease caused by an Infectious Agent isolated from Ticks in Montana.**— *Publ. Hlth Rep.* **54** no. 27 pp. 1229–1237, 6 figs., 12 refs. Washington, D.C., 1939.

The literature on the disease caused by an infectious agent [*Rickettsia diaporica*] isolated from *Dermacentor andersoni*, Stiles, in

Montana [*R.A.E.*, B **27** 146] and on Australian Q fever [see preceding abstracts] is reviewed, and descriptions are given of experiments carried out in the United States, which indicated that the two infections are closely related.

There was complete cross immunity between Q fever and the X (human) strain of the Montana infection [**27** 146], whereas there was none between either strain and two of Rocky Mountain spotted fever. There was no cross immunity between the X strain and two strains of typhus (endemic and epidemic), and though there was a suggestion of some degree of immunity produced by the typhus strains against the Q fever strain, the reverse was not true. In a well-controlled agglutination test, the serum from the man who had recovered from the Montana infection gave results practically identical with that from one who had recovered from Q fever when tested with a suspension of *Rickettsia burneti* prepared in Australia. Definite protection to guineapigs against the X virus was afforded by the X serum and the Q fever sera, while the Rocky Mountain spotted fever serum used as a control gave no protection.

Cox (H. R.). *Rickettsia diaporica* **and American Q Fever.**—*Amer. J. trop. Med.* **20** no. 4 pp. 463–469, 12 refs. Baltimore, Md., 1940.

Reference is made to the literature on the disease caused by an agent isolated from *Dermacentor andersoni*, Stiles, in Montana [*R.A.E.*, B **27** 146] and later named *Rickettsia diaporica* [**28** 80], and the name American Q fever [*cf.* preceding abstract] is suggested for it. The organism is briefly described, and accounts are given of its cultivation in tissues and tissue culture, the infection in guineapigs and the susceptibility of other animals. Tests with guineapigs have shown that American Q fever shows no cross immunity with Rocky Mountain spotted fever, Brazilian exanthematic typhus, Marseilles fever or epidemic and endemic typhus. Animals recovered from the infection caused by the agent isolated from *Amblyomma maculatum*, Koch [**28** 28] are not immune from American Q fever, but results suggested that in the reverse direction partial immunity was conferred. Dyer's results that there is complete cross immunity with Australian Q fever [see preceding abstract] are confirmed. The author, in conjunction with C. B. Philip, has recently found that incalculable numbers of *R. diaporica* are contained in the viscera and faeces of infected adults of *D. andersoni*. Vaccines including some prepared from tissues or faeces of the tick gave complete protection to most guineapigs against as many as 10,000 infectious doses. In addition, 10 vaccines prepared from adults of *D. andersoni* that were infected with both Rocky Mountain spotted fever and American Q fever rickettsiae all completely protected guineapigs against at least 1,000 infectious doses of spotted fever and 10,000 of American Q fever rickettsiae. Infection of ticks in nature with *R. diaporica* has been demonstrated in *D. andersoni* from Montana and Wyoming [**28** 112], in *D. occidentalis*, Marx, from Oregon and California and possibly in *A. americanum*, L., from Texas. The sera of 11 out of 27 persons engaged in various duties at the Rocky Mountain Laboratory showed agglutinins for *R. diaporica* ; in addition, evidence suggestive of infection was obtained in blood samples of 19 patients out of 72 samples forwarded by physicians. Of these 19 patients, 7 were from Idaho, 6 from Montana, 2 from Wyoming and

one each from Nebraska, Nevada, Oregon and Washington, all but one lived within the range of *D. andersoni* and, in most cases, there was a definite history of tick bite.

BATES (M.). **Oviposition Experiments with Anopheline Mosquitoes.**—*Amer. J. trop. Med.* **20** no. 4 pp. 569–583, 13 refs. Baltimore, Md., 1940.

Field observations in Albania indicated that the differences between the larval habitats of various races of *Anopheles maculipennis*, Mg. (which the author treats as distinct species) are largely the direct result of selection of oviposition sites by the females. The experiments here reported were undertaken to determine whether the reactions governing the selection of an oviposition site by mosquitos could be studied in the laboratory. Anophelines in captivity commonly lay their eggs in batches while resting on the surface of the water, but the author has never found eggs in cohering groups in nature in Albania, and this distribution and observation of the behaviour of mosquitos in the laboratory appeared to prove that the Albanian Anophelines, especially the races of *A. maculipennis*, normally oviposit while hovering over the water, performing a sort of "oviposition dance." This dance was first observed in the big cage [*R.A.E.*, B **28** 84] and later in smaller cages, though the tendency to rest on the water while ovipositing seemed to increase as the size of the cage decreased. A description of the dance is given from observations made by J. S. Kennedy on the behaviour of Anopheline females, mostly *A. maculipennis* race *labranchiae*, Flni., when stimulated to oviposition by smoke with which the room accidentally became filled. The tendency to lay eggs in batches in the laboratory seems to depend both on the size of the cage and on the species. During the summer of 1936, when examples of race *maculipennis* and *A. superpictus*, Grassi, were kept together in the big cage, only one cohering batch of eggs of *maculipennis* was found in a small pan of water, all the eggs in the large aquaria being scattered, while about half of the eggs of *superpictus* were in batches. Eggs of race *maculipennis* in smaller cages were usually laid in batches. Over a period of 9 days, 25 per cent. of the eggs of a Portuguese strain of race *atroparvus*, van Thiel, were scattered, as compared with 8 per cent. of those of a north German strain.

In view of the results obtained by previous workers in investigations on the effect of salinity on oviposition, notably the fact that race *atroparvus*, which breeds in brackish water in nature, and race *sacharovi*, Favr (*elutus*, Edw.), which often does so, preferred to oviposit in fresh water, whereas race *messeae*, Flni., which breeds in fresh water, did not [**13** 132; **20** 195], experiments to check these observations were started, chiefly with the north German strain of *atroparvus*. The females appeared to be more or less indifferent to the sodium chloride content of the water, but they were found to show pronounced preference for dark background colours in ovipositing and for water containing calcium [*cf.* **17** 7]. These results are taken as a clear indication that the failure of mosquitos to select solutions of sodium chloride in the laboratory does not indicate that laboratory experiments on oviposition selection are unreliable. Experiments and observations on time of oviposition gave conflicting results, but seemed to indicate that oviposition may depend on a combination of stimuli rather than on some single factor in the daily cycle of environmental changes.

HENDERSON (J. M.) & HOWARD jr. (R. S.). **A comparative Evaluation of Paris Green and Pyrethrum Emulsion as Anopheline Larvicides in Georgia ; A Progress Report.**—*Amer. J. trop. Med.* **20** no. 4 pp. 585–592, 2 refs. Baltimore, Md., 1940.

An account is given of experiments carried out in July 1938 on the comparative effectiveness against Anopheline larvae of pyrethrum emulsion and Paris green, and the comparative practicability of their use in Georgia, in view of a recommendation by a Federal Agency that pyrethrum emulsion larvicide be used in Georgia in place of drainage. The Paris green was mixed with lime at the rate of 1 : 9. The stock emulsion consisted of 1 part by volume pyrethrum extract containing 2 per cent. pyrethrins, 1 part 40 per cent. liquid potash soap, 19 parts white kerosene and 9 parts water, and was applied at dilutions of 1 : 10 or 1 : 16. Its efficiency varied directly with its rate of application (1·25, 3 or 6 U.S. gals. per acre). The results indicated that rather more than 3 U.S. gals. stock emulsion per acre was necessary to cause minimum effective mortality of Anopheline larvae or the same mortality as 0·5 lb. Paris green per acre under the conditions of the experiment, which was made on water with dense aquatic vegetation. The cost of the materials for the pyrethrum larvicide was 10–15 times that of the Paris green and lime required to produce equivalent mortality, and it is thought that other costs would increase the difference in favour of Paris green. Moreover, the pyrethrum killed or injured numerous invertebrate mosquito predators, including water-beetles, dragonfly nymphs and water spiders, while Paris green appeared not to affect them ; neither larvicide was observed to harm *Gambusia*. No difficulties were experienced in applying the Paris green, but as the emulsion did not spread appreciably where algal mats and dense growths of *Myriophyllum* and *Lemna* prevailed, it had to be applied directly on individual areas from a much shorter distance than the dust.

PAPERS NOTICED BY TITLE ONLY.

BOS (A.) & NIESCHULZ (O.). **Ueber die Fütterung von Mücken an Kanarienvögeln.** [A Method for inducing *Culex pipiens*, L., to feed on Canaries.]—*Zbl. Bakt.* (1, Orig.) **144** pp. 425–427, 2 figs. Jena, 1939. [Recd. 1940.]

VARGAS (L.). *Aëdes bimaculatus* **Coquillett, 1902, del Estado de Campeche, Mexico. Descripción del macho.** [*Aëdes bimaculatus*, Coq., from the State of Campeche, Mexico. Description of the Male.]—*Rev. Soc. mex. Hist. nat.* **1** no. 2 pp. 103–107, 3 figs., 4 refs. Mexico, D.F., 1940.

LEWIS (D. J.) & KIRK (R.). **The Male of** ***Phlebotomus affinis*** **Theodor (Diptera)** [from the Anglo-Egyptian Sudan].—*Proc. R. ent. Soc. Lond.* (B) **9** pt. 7 pp. 127–128, 4 figs., 1 ref. London, 1940. [*Cf. R.A.E.*, B **22** 28.]

ABDUSSALAM (M.). **A new Trombidiid Larva** [*Gahrliepia homunguis*, sp. n.] **Parasitic on the House Rat** (*Rattus* [*Mus*] *rattus*) [in the United Provinces].—*Indian J. Ent.* **1** pt. 3 pp. 83–86, 1 fig., 8 refs. New Delhi, 1939. [Recd. 1940.]

BAISAS (F. E.). **Malaria and Mosquitoes in Lahuy Island, Camarines Sur.**—*Mon. Bull. Bur. Hlth P. I.* **19** no. 11 pp. 425–435, 7 figs. Manila, 1939. [Recd. 1940.]

An account is given of the malaria situation on Lahuy Island, Camarines Sur, which was stated to have been free from the disease until the importation of labourers for the mines of the Pan-Philippines Corporation. An outbreak that occurred in the camp of the Corporation and had its peak in July and August 1939 resulted in an increase in the number of carriers and indicated that unless control measures were undertaken against *Anopheles minimus* var. *flavirostris*, Ludl., which is the chief vector in the Philippines [*cf. R.A.E.*, B **22** 258], further epidemics would take place until eventually the disease became endemic ; this is particularly likely, in view of the high susceptibility of the indigenous population to the imported strains of malaria parasites. Malaria and mosquito surveys were carried out in the most important communities of the island, and the results are shown in tables. The malaria surveys and the case records of the Corporation's physician support the view that malaria was largely if not entirely imported. The surveys were undertaken at a time when both the incidence of malaria and the density of var. *flavirostris* were low, but they indicated that the foci of infection are the camp and the neighbouring village and that the disease has spread from them to the other communities. The island is too small to permit the formation of permanent streams of any size, and most of them dry up shortly after the end of the wet season. There were only four permanent streams in the area surveyed, but larvae of *flavirostris* or *A. maculatus*, Theo. [*cf.* **23** 99] were found in all of them, and both were numerous in the one that most directly affects the camp and village. There are also temporary streams that may prove dangerous to both camp and village. At the onset of, and soon after, the rainy season, when all streams contain flowing water, the output of *flavirostris* is probably high. Other mosquitos collected included three Anophelines, *A. barbirostris*, Wulp, *A. vagus* var. *limosus*, King, and *A. litoralis*, King.

A tentative plan of control work is appended.

JOHNSON (C. G.). **The Longevity of the fasting Bed-bug** (*C. lectularius* **L.**) **under experimental Conditions and particularly in Relation to the Saturation Deficiency Law of Water-loss.**—*Parasitology* **32** no. 3 pp. 239–270, 11 figs., 22 refs. London, 1940.

The following is the author's summary of this paper, which comprises data collected primarily to determine how long the bed-bug, *Cimex lectularius*, L., is likely to remain alive in an empty house in England under extreme circumstances [*cf.* also *R.A.E.*, B **28** 212] : With unfed 1st instars the relation between mean length of life and saturation deficit at constant temperatures between 7 and 15°C. (44·6 and 59°F.) at relative humidities between 7 and 90 per cent. is hyperbolic. The relationship becomes more linear at higher temperatures. At constant saturation deficits the insects live longer at 15°C. than at lower temperatures. Longevity also decreases with rise of temperature above approximately 15°C. In general, the longevity curves, except for those at temperatures below 15°C., bear a very similar relation to saturation deficit and to each other as the reciprocal curves for rate of water-loss at the different temperatures. The

influence of climatic factors on longevity at constant temperatures is discussed at length, and it is concluded that overmuch of the temperature and humidity range survival time is limited by water-loss. At the higher humidities it is thought that either food, or perhaps an excessive accumulation of water within the insect, limits survival and causes a departure from the hyperbolic relation of longevity to saturation deficit.

The effects on longevity of a single meal are discussed. The principal effect of a blood meal is to increase the time of survival. But the factors which limit survival at different humidities appear to be the same as with unfed bugs, except at high humidities at temperatures below about 15°C. Mellanby's data on the rate of water-loss from fasting adult bed-bugs [**20** 283] is analysed. It is found that the rate of water-loss is directly proportional to saturation deficit at constant temperatures between 8 and 37°C. [45·4 and 98·6°F.] and between 0 and 90 per cent. R.H. Although the rate may always be directly proportional to saturation deficit, the expression rate/saturation deficit is not always constant. Rate$=K+b$ (saturation deficit), where K varies with temperature and b remains constant.

Longevity in relation to host blood is discussed. Rabbit blood appears to be slightly less favourable to survival than human blood. If bugs are allowed to feed to repletion, longevity is not correlated with the size of the meals, or with the weight of the unfed insect. Virgin females live longer than mated ones, but no effects of mating on survival were noticed with males. Mated males tend to outlive mated females except at very low temperatures: virgin females live longer than unmated males. The results of other workers and the possible causes of some discrepancies are discussed. The maximum survival times of bugs are listed. Adults and 5th instars live longer than other stages. In a house which has remained empty for a long time it is probable that 5th instars and adults, particularly unmated female adults, would predominate in the population. The longest observed survival was between 562 and 572 days.

BUXTON (P. A.). **Studies on Populations of Head-lice** (*Pediculus humanus capitis*: **Anoplura**). **III. Material from South India.**— *Parasitology* **32** no. 3 pp. 296–302, 3 refs. London, 1940.

In connection with his studies on the prevalence of head lice, *Pediculus humanus*, L., race *capitis*, DeG. [*cf. R.A.E.*, B **26** 116], the author examined 1,437 crops of hair removed from men on admission to jail in South India. Of these, 356 were infested with 1–10 lice, 173 with 11–100 and 14 with over 100. There was a high positive correlation between weight of hair and infestation; 14·6 per cent. of the men with less than 10 gm. hair were infested, 39·9 per cent. of those with between 10 and 19·9 gm. and 56–59 per cent. of those with over 20 gm. An apparent negative correlation with age seemed to be due to the older men having less hair, and large differences in the rates of infestation between different religious groups also seemed to be due to a great extent (but not entirely) to differences in weights of hair. There was no evidence that rates of infestation differ with the season.

BUXTON (P. A.). **The Biology of the Body Louse** (*Pediculus humanus corporis* : **Anoplura) under Experimental Conditions.**—*Parasitology* **32** no. 3 pp. 303–312, 7 refs. London, 1940.

Details are given of a number of experiments on the biology of the louse, *Pediculus humanus*, L., that have been carried out by the author in the course of the last four years. For all the experiments the lice were kept in flat cardboard pill-boxes, 2 cm. in diameter and 8 mm. deep inside, with a hole 1·5 cm. in diameter in the bottom covered with bolting silk stuck to the outside of the box with shellac dissolved in spirit. For most purposes a bolting silk with 19 meshes per cm. and an aperture 0·4 mm. square was used, but since unfed nymphs of the first instar can crawl through this, one with 29 meshes per cm. and an aperture about 0·27 mm. square was used for them. Inside the box was placed a piece of black tape on which the lice can rest and lay their eggs. The boxes are held on the calf of the leg by means of the leg of a boy's sock worn upside down so that the ribbing at the top prevents the boxes from sliding down. The advantage of this method is that many boxes can be worn on one leg and they can be moved from time to time to prevent irritation. The boxes were taken off at night, so that the insects were exposed to low and uncontrolled temperatures for about 8 hours a day and thus to conditions resembling those in a garment taken off at night. This appears to produce considerable seasonal differences in length of life, etc., and possibly explains the high degree of inconsistency observed in some of the experiments. The boxes were examined once in 24 hours.

When 34 pairs of adults were kept each in a separate box from the day they had moulted until they died, the mean life of the male was 30·56 days and that of the female 28·76 days, the difference being much less than statistically significant. Seventeen pairs were studied during December–March and seventeen during April–June, but no significant difference could be found in the length of life of either sex. The mean length of life was not affected by isolating males and females before they became adult and keeping them singly in separate boxes or by keeping a number of pairs (6–7) or of virgin females (13–14) together in one box. When a single male was kept for 24 hours in turn with each of several females, the lengths of life of the latter were normal and the number of eggs laid close to that by normal females. However, the mean length of life of a single young female kept with six or more males was invariably shorter than normal ; there was also a considerable reduction in the number of eggs.

Pairs almost always produce fertile eggs, provided that they are in the same box for a few days ; the females of the 34 pairs already mentioned laid a mean of 103·82 eggs apiece. Usually no eggs are laid during the first 2 days of life or on the last day, so that the reproductive life of a female is 3 days shorter than its total adult life. The number of eggs laid daily is influenced by the length of life, females that live longest tending to lay more eggs per day of reproductive life. Fertile eggs are laid after 2–3 days, even when one of a pair is over 20 days old and the other less than 1. The daily production of eggs by virgin females seems to differ little from that of paired females, but samples of eggs from 69 unpaired females all shrivelled within a few days.

There are great divergencies in sex ratio in natural populations of lice, and it is known that the progeny of a single pair are frequently

all of one sex or nearly so. A table is given showing the sex ratio in offspring of a number of pairs of two strains of lice, but it is admitted that the ratios shown are "secondary," since a considerable mortality had occurred among eggs and larvae. In one instance, the emergence of 190 males and only 3 females led to the extinction of a strain, and it is suggested that the same thing might occur in nature if a man killed nearly all the lice infesting him and chanced to leave only a few, of which the offspring were unisexual. From several experiments, it is concluded that there is no evidence of a change in sex ratio as the age of the parent lice increases, or that crowding or partial starvation produces a differential mortality during development and so disturbs the "secondary" sex ratio.

When the lice are reared by the method described there are great individual differences in the duration of development, the final (third) moult occurring from 12 to 26 days after hatching. The period is influenced to some extent by season and is shorter in summer, but does not vary with sex. The question of nymphal mortality is discussed; it appears to be due to a multiplicity of causes.

Carrick (R.) & Bullough (W. S.). **The Feeding of the Tick, *Ixodes ricinus* L., in Relation to the Reproductive Conditions of the Host.** —*Parasitology* **32** no. 3 pp. 313–317, 1 fig., 5 refs. London, 1940.

It has been suggested by J. MacLeod [*R.A.E.*, B **20** 274] that the susceptibility of a sheep to attack by *Ixodes ricinus*, L., depends on its physical condition and breed, and from field observations he reported that a barren ewe was markedly less infested than two pregnant ewes on the same pasture. Experiments designed to test this hypothesis were carried out in mid-winter, using the hedgehog, *Erinaceus europaeus*, which is a natural host of the tick. Unfed nymphs and adult female ticks attached themselves and engorged successfully on hibernating hedgehogs, on hedgehogs in which full breeding conditions had been induced by light and heat and on those into which sex hormones had been injected. The adult females required a longer time to complete engorgement on the hibernating animals, but this may be explained by the lower temperature of their blood. Thus parasitism does not appear to be related to the reproductive condition of the host animal. Moreover, the amount of sex hormone in the hosts' blood had no apparent immediate effect on the fecundity of the ticks.

Nieschulz (O.) & Bos (A.). **Versuche mit Mücken und Geflügelspirochäten.** [Experiments with Mosquitos and Fowl Spirochaetes.]—*Zbl. Bakt.* (1. Orig.) **145** pp. 258–261. Jena, 1940.

To ascertain the behaviour of fowl spirochaetes [*Spirochaeta anserina* (*gallinarum*)] in *Culex pipiens*, L. [*cf. R.A.E.*, B **25** 5], *Aëdes aegypti*, L., and *Theobaldia annulata*, Schr., suspensions of mosquitos that had fed 1–20 days previously on infected fowls were injected intramuscularly into healthy ones. It was thus shown that females of all three species became infected in a few cases, but the spirochaetes lost their virulence within 1–2 days and could not have developed in the mosquitos. No transmission was obtained when females of *A. aegypti* were transferred within 2–60 seconds from infected fowls to healthy ones and allowed to complete their meal. It is concluded that mosquitos are of no practical importance in the transmission of the spirochaete.

NAUDÉ (T. J.). **Insects and Human Affairs.**—*Pamphl. S. Afr. biol. Soc.* no. 10 pp. 67–77. Pretoria, 1939. [Recd. 1940.]

Attention is drawn to the great antiquity of insects as proved by geological records, their abundance and the diversity of their structure and bionomics, to the influence on mankind and history exercised particularly by those that carry disease and to the heavy mortality from insect-borne diseases attending settlement of the tropics. The adverse effects of insect life on man are stated to be now greater than ever before, and figures are quoted to indicate the extent of the financial loss they cause. The influence of man's activities on insect problems is shown, and particular importance is attached to the great increase in travel and trade intercourse. A brief historical outline is given of work on insect control. In conclusion, reference is made to the various activities of beneficial insects.

ORTLEPP (R. J.). **Animal Parasites and their Effects on Mankind.**—*Pamphl. S. Afr. biol. Soc.* no. 10. pp. 101–112. Pretoria, 1939. [Recd. 1940.]

Four groups of internal parasites of man are discussed, two of which, those causing malaria and sleeping sickness, are insect-borne. The early records of these diseases are briefly reviewed, the distribution of the various forms of each is given, and the life-cycles of *Plasmodium* in man and mosquito and of *Trypanosoma* in man and *Glossina* are outlined.

CHARLES (V. K.). **Notes on Entomogenous Fungi.**—*Plant Disease Reporter* **23** no. 21 p. 340. 1939. (Abstr. in *Rev. appl. Mycol.* **19** pt. 4 pp. 213–214. Kew, 1940.)

Individuals of *Anopheles quadrimaculatus*, Say, from Florida were found to be attacked by *Beauveria bassiana* and *Spicaria* sp., both of which appear to be recorded from mosquitos for the first time.

STRONG (L. A.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, 19**[38–]**39.**—117 pp. Washington, D.C., U.S., Dep. Agric., 1940.

Part of this report (pp. 84–88) deals with work carried out in 1938–39 on insects affecting man and animals in the United States.

Of several new insecticides that have proved superior to pine-tar oil for the protection of animals against infestation by *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.), diphenylamine, although not quite so effective as the others, appeared to be the most practical for general use on account of its availability and low cost. Its application to wounds every third day will prevent them from becoming infested with maggots of *C. hominivorax* and other flies. Laboratory tests with homologues of benzene as larvicides for *C. hominivorax* showed that additions of 5 and 10 per cent. thiophene and 10 per cent. naphthalene to benzene enhance its toxicity. Undiluted toluene appeared to be slightly superior to benzene as a larvicide in the laboratory. Guineapigs that have survived an initial infestation by larvae of *C. hominivorax* show an increased tolerance of subsequent infestation [*R.A.E.*, B **27** 217], but no such tolerance was acquired by guineapigs or sheep that received six doses of vaccines composed of mature

tub-reared or sterile larvae of *C. hominivorax*, pure cultures of *Proteus chandleri*, an organism commonly associated with these larvae in wounds, trypsin, pepsin, or fluids from wounds infested with *C. hominovorax* in guineapigs, sheep and goats. In Texas, it has been fairly definitely established over a three-season period by cage experiments and trapping surveys that *C. hominivorax* overwinters normally in restricted areas south of 30°N. lat. [*cf.* **26** 85, 110]. During the coldest years, it is eradicated from all of Texas except a small area in the lower Rio Grande Valley. The area in which it overwinters in Arizona is normally limited to the low valleys in the southern part of the State. It is able to survive in the south-east as far north as Valdosta, Georgia, during normally mild winters, but the limit is about 100 miles farther south in cold ones.

The second season's tests on a large ranch in Texas continued to show the effectiveness of an automatically operated trap for the control of the horn-fly [*Lyperosia irritans*, L.] on cattle [*cf.* **26** 248]. The numbers of flies per head on pastures where the traps were in operation seldom exceeded 150, whereas in surrounding pastures they were 3,500–4,000. Research has shown that a dip consisting of 100 lb. wettable sulphur plus a wetting agent and 10 lb. cubé or derris powder containing 5 per cent. rotenone in 1,000 U.S. gals. water will kill adults of all species of lice attacking sheep, goats and cattle [*cf.* **28** 101] in the United States as well as adults of the sheep tick [*Melophagus ovinus*, L.]. It also appears to be effective against lice on horses.

In the course of work on the 23 species of mosquitos found in the Pacific North-west, two methods of control have been developed. The first consists in destroying the habitat of the flood-water species, *Aëdes vexans*, Mg., and *A. lateralis*, Mg. (*aldrichi*, D. & K.) by clearing out the brush where the eggs have been deposited, and the second of maintaining water levels for the control of the snow-water species, *A. aboriginis*, Dyar, *A. hexodontus*, Dyar, *A. fitchi*, Felt & Young, and *A. communis*, DeG. A study of the effects of the Bonneville dam on the mosquito population showed that the impounding of the water had caused a decrease in the numbers of the important flood-water species for 50 miles above the dam. Studies in Delaware and New Jersey on the effect of ditching on marsh conditions indicated that changes in the flora and fauna depend largely on the extent to which the water table is lowered and that drastic lowering is not essential for mosquito control.

Murray (C. A.). **A fundamental Error in the Peet-Grady Method.**—*Soap* **16** no. 6 pp. 111, 113, 115, 117, 119, 125, 12 refs. New York, N.Y., 1940.

The changes and developments in the Peet-Grady method of testing contact liquid insecticides against the housefly [*Musca domestica*, L.] are reviewed [*R.A.E.*, B **26** 244 ; **27** 22, 23], the possible sources of error are pointed out, and it is stated that the present concept of the test is that the use of the Official Control Insecticide [**27** 23] renders the results significant in spite of defects in experimental technique and variation in the vitality of the flies. The author considers, however, that the use of the O.C.I. has been taken as licence to modify experimental detail according to individual convenience. Attempts have been made over a period of about two years to determine the cause of the inaccuracy of the method, and special attention has been given

to spraying technique, particularly the uniformity of the dose received by individual flies. A colorimetric method of determining the individual dose received was developed. Flies were sprayed with a dyed solution, the colour was afterwards washed from them, made up to a standard volume and measured directly against a known standard in a colorimeter. The procedure is described in detail. The ratio of the greatest dose to the least in six tests each involving about 100 flies varied from 2·60 to 6·44 for males and 2·58 to 5·15 for females. Tests are described which showed that the variation in average dose per fly and the percentage kill is as great as if from 12 to 36 cc. of spray were taken at random for each test. The effect of this on the reproducibility of results, the sensitivity of the test, and the paired test procedure is analysed. The variation is shown to invalidate the principle of comparison with a standard insecticide.

Sullivan (W. N.), Goodhue (L. D.) & Fales (J. H.). **Insecticide Dispersion. A new Method of dispersing Pyrethrum and Rotenone in Air.**—*Soap* **16** no. 6 pp. 121, 123, 125, 2 figs., 8 refs. New York, N.Y., 1940.

As the development of methods for the rapid vaporisation or dispersion of relatively non-volatile insecticides would broaden the range of materials that could be used as fumigants, and as Goodhue and Sullivan have recently found that smoke from burning derris and pyrethrum has considerable fumigating action on the house-fly [*Musca domestica*, L.] but that the burning destroys much of the material before it can be dispersed, a better method of dispersion was sought. In preliminary tests, rapidly boiling solutions of derris and pyrethrum in different solvents produced some toxic vapours, but sprinkling pure rotenone on a hot surface was more effective, and slowly dropping solutions of rotenone and pyrethrum oleoresin in different solvents on a hot surface gave still better results. There was considerable spattering, but this was overcome by directing a spray of the solution against the heated surface. The results of investigations on the effect on the house-fly of pure rotenone and pyrethrum oleoresin applied separately or in combination in this manner are reported. The solvent used was safrol, with which a copious fog, or aerosol, is produced on account of its high boiling point. Per 100 cc. of solution, 2 gm. rotenone or commercial pyrethrum oleoresin having a total pyrethrin content of 25·1 per cent., or 1 gm. of each, was used. The apparatus consisted of an atomiser with the nozzle mounted 7 ins. above the centre of an electric hot plate, which was kept at about 375°C. [707°F.]. A small electric pump was used to maintain the air pressure. The tests were made in a furnished room with a capacity of 1,100 cu. ft. and a temperature of 28–30°C. [82·4–86°F.] in which about 150 flies were liberated and 10 cc. solution was sprayed for each test. " Knockdown " was estimated after 10 minutes, and the flies were removed to a cage and fed after an exposure of 1 hour. In two tests, the percentages of flies down after 10 minutes and dead after 48 and 72 hours were 100, 72 and 74 with pyrethrum oleoresin, 15, 65 and 83 with rotenone and 90, 81 and 95 with equal parts of the two. There was a mortality of 4 per cent. in the untreated control, and the effect of safrol alone was slight. There was no visible deposit, but the odour was noticeable. When about 500 adult mosquitos of the genus *Culex* from 2 to 3 days old were exposed for 10 minutes to the mist produced

by 20 cc. of a solution containing 100 mg. pyrethrins in ethyl alcohol, all were down within 5 minutes and 99 per cent. were dead after 48 hours. No males survived. Carbon dioxide under pressure was used in the atomisation to reduce the risk of fire and the formation of aldehydes. Rotenone and pyrethrum applied in this form gave little or no mortality of large nymphs and adults of the American cockroach [*Periplaneta americana*, L.]. The manner in which dispersion is accomplished is discussed. To obtain the same mortality by burning as by spraying a hot surface, about 20 times as much material is required. Other advantages of the dispersion method are that under favourable conditions the insecticide will remain in suspension in air for several hours, less solvent is required than for spraying, there is practically no deposit, and toxic action is accelerated.

EAGLESON (C.). **Livestock Sprays. A rapid Method for determining their Toxicity.**—*Soap* **16** no. 7 pp. 96–99, 117, 6 figs., 4 refs. New York, N.Y., 1940.

It is thought that even the best commercial sprays when applied in barns or sheds do not kill *Musca domestica*, L., or *Stomoxys calcitrans*, L., though the very susceptible *Lyperosia* (*Haematobia*) *irritans*, L., is reasonably well controlled by them. This is apparently because, during hot weather when flies are abundant, it is not practicable to close barns and sheds to provide for the fumigatory action of petroleum-base sprays, and because sprays compounded on the basis of tests made in a fumigatorium are likely to be too weak when applied in well ventilated situations. A description is given of a technique for determining the toxicity to *M. domestica* of sprays for livestock in conditions simulating those in barns, with reasonable accuracy but without taking up excessive time. The method of obtaining uniform samples of flies for testing is given. Flies to be sprayed are placed in cylinders of screen wire, which are randomised and placed singly in a spray tunnel that discharges into a hood and filter column through which a constant, controllable stream of air is drawn by a vacuum cleaner. The spray mist is absorbed by the filter and the dust bag on the cleaner. The flies receive only the insecticide that touches them as a travelling mist, and after the measured dose has been atomised, clean air is passed through. A uniform time after spraying, according to the period necessary for the flies to become paralysed, the flies from all cylinders sprayed with the same material are placed together in a recovery cage with shelves of wire gauze, and maintained at constant temperature and humidity with a constant air flow.

Three experiments on the effect of this aeration on mortality are described. The difference in mortality caused to aerated and protected flies was 14–20 per cent., and it appeared that the mortality from livestock sprays is more reduced by ventilation than the mortality from household sprays.

Insecticides tested in the equipment here described may be rated in relation to the official test insecticide in the manner now official with the Peet-Grady method [*R.A.E.*, B **27** 23], but the method of Bliss [**27** 203] is considered preferable. The method of mathematically adjusting the results obtained is given. Examples of results indicate that a chemical assay of toxicants and determination of the specific gravity, distillation range and unsulphonatable residue of the carrier are not an entirely dependable index of toxicity for livestock sprays.

Symposium on Fifty Years of Entomological Progress.

Marlatt (C. L.). **Part I, 1889 to 1899.**—*J. econ. Ent.* **33** no. 1 pp. 8–15. Menasha, Wis., 1940.

Caesar (L.). **Part II, 1899 to 1909.**—*T.c.* pp. 15–21.

Metcalf (C. L.). **Part III, 1909 to 1919.**—*T.c.* pp. 21–30.

Essig (E. O.). **Part IV, 1919 to 1929.**—*T.c.* pp. 30–58, 15 pp. refs.

Rohwer (S. A.). **Part V, 1929 to 1939.**—*T.c.* pp. 58–65.

The first of these papers deals with the decade following the foundation of the American Association of Economic Entomologists, the first meeting of which was held on 30th August 1889. It contains a section on medical entomology, in which field the outstanding events of the period were the determination of the relation of mosquitos to malaria and yellow fever, and the discovery of a blood-inhabiting protozoan [*Piroplasma bigeminum*] as the cause of Texas or southern cattle fever and its relation to its two hosts, cattle and the cattle tick, *Boophilus* (*Margaropus*) *annulatus*, Say. In the second paper, it is stated that in the years 1899–1909 progress was greater in medical entomology than in any other branch of the subject. At the beginning of the period, it was definitely proved that yellow fever was carried by *Aëdes aegypti*, L., and the control measures taken in consequence of this discovery were so thorough that the last real epidemic of yellow fever in the United States occurred in 1905. Great advance was made in malaria control and in lessening the danger of the carriage of typhoid and other diseases by the house-fly [*Musca domestica*, L.]. Work on the control of *B. annulatus*, the vector of Texas fever, was much advanced. During the third decade, reviewed in the next paper, the fundamental work on typhus and trench fever was accomplished, and many branches of medical and veterinary entomology advanced considerably, both in the United States and abroad. The fourth paper includes a review of the literature published during 1919–1929 by North American workers on medical and veterinary entomology. The last, in which the years 1929–1939 are dealt with, includes a brief account of the action taken against the screwworm [*Cochliomyia hominivorax*, Coq.], which appeared in the south-eastern States for the first time in 1933, and concludes with a reference to a new and important branch of medical entomology, the treatment of wounds by means of blowfly larvae and compounds found in their excretions.

Deonier (C. C.). **Carcass Temperatures and their Relation to Winter Blowfly Populations and Activity in the Southwest.**—*J. econ. Ent.* **33** no. 1 pp. 166–170. Menasha, Wis., 1940.

The following is substantially the author's summary: From observations on 33 carcasses in south-western Texas and 40 in southern Arizona during the winters of 1935–36 and 1936–37, it was found that carcasses of sheep, goats, horses and cattle showed temperatures considerably higher than those of the atmosphere. Such temperatures were due partly to heat absorbed from the sun, but principally to heat generated by blowfly larvae, which were developing in the carcasses. Temperatures 70 Fahrenheit degrees above those of the atmosphere were observed in certain parts of carcasses and more than 50 degrees above in the larval masses. The heat generated by blowfly larvae in carcasses enables the larvae to continue to develop and the species to

survive during periods when weather conditions are unfavourable to adult activity.

Observations on the minimum temperatures at which the adults of various species become active about carcasses showed that 40 to 50°F. is the range for *Calliphora* spp. and *Cynomyia cadaverina*, R.-D., 41 to 50° for *Phormia regina*, Mg., 50 to 55° for *Lucilia sericata*, Mg., 50 to 60° for certain carcass-breeding species of *Sarcophaga*, and 55 to 60° for *Cochliomyia macellaria*, F. The influence of other factors, such as cloudiness, humidity, wind, and time of day, probably determine the range of the minimum temperatures at which blowflies become active.

In small carcasses, such as those of lambs and small animals, blowfly larvae were not able to generate and maintain heat sufficiently above atmospheric temperatures during the winter to afford favourable conditions of development.

PHILLIPS (A. M.) & SWINGLE (M. C.). **Rearing of Mosquito Larvae and Effect of Diet on their Resistance to Rotenone and Nicotine.**—*J. econ. Ent.* **33** no. 1 pp. 172–176, 3 refs. Menasha, Wis., 1940.

Mosquito larvae have been widely used for a number of years as test insects for estimating the toxicity of insecticides, because of the ease with which they can be reared. In this paper, the authors' technique for rearing and testing larvae of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and experiments on the influence of diet on the resistance of the larvae to rotenone and nicotine are described. Eggs collected in the field were used. Of the various culture media tried, a mixture of baker's yeast and dried blood was the most satisfactory under the prevailing conditions. From 12–15 egg clusters were placed in each jar, which contained about 3 U.S. quarts water, and the jars were kept at 28°C. [82·4°F.] in a water bath. The eggs usually hatched within 24 hours, and 4 cc. of a stock suspension of yeast containing 1 lb. baker's yeast per litre of water and 1 cc. of stock solution of blood albumen made by dissolving 20 gm. commercial powder (95 per cent. soluble) in 200 cc. water, were then added to each jar. Two days later 8 cc. of the yeast suspension and 2 cc. of the blood-albumen solution were added, and on the fourth day a like amount. Under these conditions the larvae reached the fourth instar in 5–7 days. They were then removed from the jars and washed with distilled water. The tests were made in beakers, which contained 100 cc. distilled water and the sample of insecticide to be tested and were kept in the water bath for 18 hours at 28°C. At the end of this period, the number of dead larvae was determined.

There were considerable variations in the resistance of different groups of larvae. The results of tests on the same lot of larvae varied by as much as 30–40 per cent., and those of tests on different lots of larvae reared, over a period of time, on the same diet by as much as 50 per cent. The reason was undoubtedly physiological. The factors which influence this physiological condition are not entirely understood, but it seemed probable that the kind and quantity of food eaten would have a direct influence on the constitution of the larvae. It was therefore attempted to rear groups of larvae that would display, respectively, maximum and minimum resistance to a given insecticide by varying the diet. Ten media were tested in 30 different concentrations and combinations, and the results, which do not warrant any

definite conclusions as to their comparative value, indicated that variations in the conditions of the larvae are more quickly produced by quantitative than qualitative changes of diet.

Most of the diets produced satisfactory larvae for testing purposes, but several were in the upper limits of concentration and caused considerable mortality in the rearing jars. Variation in the resistance of the larvae was tested by exposure to rotenone at 5 parts per million by weight and nicotine at 100 parts per million by volume. In general, the resistance of the larvae increased with the concentration of the diet, except when the latter was in excess of their requirements. The figures for nicotine show a greater variation than those for rotenone, indicating that the two compounds have a different physiological action and therefore may not be resisted to the same degree. It would appear that larvae can be so reared as to show almost complete susceptibility or complete resistance to rotenone and nicotine at the concentrations used. From the series of tests that have been made, it is clear that available food is not the only factor influencing resistance. Considerable variation will be present even when the food medium and the temperature are accurately controlled.

Hixson (H.). **Field Biology and Environmental Relationships of the Gulf Coast Tick in Southern Georgia.**—*J. econ. Ent.* **33** no. 1 pp. 179–189, 2 figs., 8 refs. Menasha, Wis., 1940.

Although it has been known since 1912 that *Amblyomma maculatum*, Koch, produces conditions in the ears of domestic animals favourable to screw worms [*Cochliomyia hominivorax*, Coq.], it was not until 1935 that it was shown to be the principal factor predisposing animals to infestation by the latter. A detailed study of its bionomics, the salient features of which have already been noticed [*R.A.E.*, B **25** 80], was carried out between September 1935 and December 1936 in southern Georgia, and the results are here recorded. Lists are given of the hosts on which larvae and nymphs were found, and the important ones are discussed. In addition to a number of birds and rodents, the hosts of the larvae included lamb and kid, and those of the nymphs, sheep and calf. The hosts on which adults were found were sheep, pig, goat, cattle, dog, grey fox and mule. Attachment occurs almost exclusively inside the ear. The adults seek hosts from mid-April to early October, but the greatest activity occurs from the latter part of June to the latter part of September. The susceptibility of adults to desiccation is probably the most important factor restricting distribution.

Cheng (T. H.) & Campbell (F. L.). **Toxicity of Phosphorus to Cockroaches.**—*J. econ. Ent.* **33** no. 1 pp. 193–199, 2 figs., 9 refs. Menasha, Wis., 1940.

Phosphorus dispersed in a viscous medium (phosphorus paste) has been used successfully for many years in the United States for the control of rodents and certain species of cockroaches. Nothing is yet known, however, about the toxicology of phosphorus with respect to insects. Investigations were therefore carried out in the laboratory on the relative toxicity of phosphorus, sodium arsenite and sodium fluoride as stomach poisons for *Periplaneta americana*, L.; on the

susceptibility of *Blattella germanica*, L., to phosphorus; and on the effect of phosphorus on *P. americana* by injection, by contact and by exposure to fumes. A commercial phosphorus paste consisting of 2 per cent. phosphorus finely dispersed and suspended in a viscous medium was used for all the tests, most of which were made on nymphs approaching maturity. By quantitative feeding of phosphorus paste diluted with syrup, the median lethal dose (M.L.D.) of phosphorus for *P. americana* was found to be 0·020 mg. per gm. body weight, showing it to be highly toxic to this cockroach. It was much more toxic than sodium arsenite or sodium fluoride supplied in the same viscous medium, and was imbibed more rapidly and with less regurgitation than were the other two poisons. Sodium arsenite was more toxic in water than in syrup, but even in water it was less toxic than phosphorus.

By a similar method, the M.L.D. of phosphorus for *B. germanica* was found to be 0·13 mg. per gm. body weight. It was expected that a given volume of paste would be taken more slowly by *B. germanica* than by *P. americana*, because of the great difference in size, but the rate was much less than could be accounted for by this factor, and it appeared that the phosphorus paste was not attractive to *B. germanica*.

Phosphorus paste, diluted with physiological salt solution, was apparently somewhat less toxic to *P. americana* when injected into the body than when administered by mouth. Phosphorus paste and the paste without the phosphorus killed the cockroaches in average periods of 1·8 and 5·6 days when painted on various parts of the body, the mouth-parts being shielded from contact with it; controls survived for 12·6 days. In a small closed space, the cockroaches were killed within 24 hours by phosphorus paste with which they were not in contact. It is not known whether this was due to the action of phosphorus vapour, depletion of oxygen by the oxidation of the phosphorus, or desiccation of the insects by the oxides of phosphorus.

KELLEY (T. F.). *Ornithodoros turicata* **in California (Arachnida, Acarina).**—*Pan-Pacif. Ent.* **16** no. 3 pp. 106–107, 6 refs., San Francisco, Calif., 1940.

An early nymphal form of *Ornithodorus turicata*, Dugès, was taken from *Citellus beecheyi fisheri* 20 miles north-east of Madera, California, in August 1939. This is the first definite record of the tick in this State since 1908. Its presence so far north in the San Joaquin Valley indicates a wider distribution in California than has previously been reported.

LE VAN (J. H.). **Viability of** *Aëdes aegypti* **Eggs.**—*Publ. Hlth Rep.* **55** no. 20 p. 900. Washington, D.C., 1940.

Eggs of *Aëdes aegypti*, L., laid on 12th June 1938 in small wooden troughs containing water were put aside and left undisturbed in the humid atmosphere of an insectary in Florida for a year and immersed in tap water on 12th June 1939. A few larvae hatched, and some of them were reared to the adult stage. No frost occurred during the experiment.

Cooley (R. A.) & Kohls (G. M.). **Two new Species of Argasidae (Acarina : Ixodoidea).**—*Publ. Hlth Rep.* **55** no. 21 pp. 925–933, 1 pl., 2 figs., 5 refs. Washington, D.C., 1940.

The new Argasids described in this paper both from adults and nymphs are *Ornithodorus dyeri*, collected on bat guano in Arizona [*R.A.E.*, B **28** 198], and *Otobius lagophilus*, which is widespread in the western United States and Canada and infests rabbits.

Williams (C. L.). **Disinsectization of Aircraft.**—*Publ. Hlth Rep.* **55** no. 23 pp. 1005–1010, 2 pls., 1 fig., 2 refs. Washington, D.C., 1940.

Very few live mosquitos have been discovered in aircraft arriving at Miami, Florida, from foreign ports since spraying of their interiors while they are in flight has been carried out [*cf. R.A.E.*, B **24** 33 ; **27** 215] to prevent the introduction of mosquitos infected with yellow fever and *Anopheles gambiae*, Giles, from South America into the United States. As, however, the spraying is not carried out under the supervision of a Government official, the presence of passengers renders thorough spraying difficult, and certain compartments cannot be readily opened while the aircraft is in flight, it was thought that better protection would be afforded by careful and thorough spraying of the interior of the aeroplanes when they stopped at a point between South America and the United States. The method of spraying them on the water at Port of Spain, Trinidad, has, therefore, been adopted.

The spraying is carried out under the supervision of an inspector of the Public Health Service. All the openings of the aircraft are closed and all spaces inside the fuselage, including the bilges, are opened and the entire interior sprayed with an air-pressure sprayer, the amount of spray used being double that which has been shown experimentally to be sufficient to kill all exposed mosquitos. As soon as the spraying is completed, the operator leaves the aeroplane and it is left closed for 10 minutes. It takes off within 30 minutes of the beginning of spraying. Laboratory experiments have shown that the insecticide remaining in it has some repellent action against mosquitos attempting to enter and probably kills most of those that do enter. The sprayer used was specially designed for the purpose by H. A. Johnson and G. L. Dunnahoo. A diagrammatic drawing with explanatory notes is given showing its construction. It has three essential features. The first is a very fine orifice at the spray nozzle through which the insecticide is forced under pressure into a mixing chamber, where it is further broken up by a blast of air under pressure coming from all sides. The air and the atomised insecticide then pass out through a somewhat larger opening in the cap of the spray nozzle in the form of mist, which for practical purposes leaves no deposit. The distance of the cap of the nozzle from the fine orifice can be altered, and the cap and the piece containing the fine orifice can be removed for cleaning. The second feature is a " bleeder " consisting of a small tube from the top of the insecticide reservoir to the outside through the air-valve mechanism. It is opened when the air valve is closed and relieves pressure on the insecticide, thus preventing dripping at the nozzle. The third is that the container for the insecticide is of glass in a protective metal cover in which windows have been cut. Calibrations on the edges of the windows enable the amount of insecticide contained in the reservoir to be read. This makes it possible to use the right

proportion of spray in each compartment of the aircraft. The sprayer may be operated at pressures of 25–50 lb., but is most efficient when pressures of 30–40 lb. are used.

PACKCHANIAN (A.). **Natural Infection of** *Triatoma heidemanni* **with** *Trypanosoma cruzi* **in Texas.**—*Publ. Hlth Rep.* **55** no. 29 pp. 1300–1306, 2 pls., 11 refs. Washington, D.C., 1940.

About 65 per cent. of 150 examples of *Triatoma heidemanni*, Neiva, collected in October 1937 and September 1938 at Temple, Texas, were found to be naturally infected by trypanosomes. The bugs were collected chiefly in dwellings in different sections of the city. The nymphs were usually found in mattresses and bedding and occasionally on the wall-paper or between cracks of wood in bedrooms. All adults examined were infected, but the 42 nymphs collected in different dwellings were free from flagellates. However, 6 adults and 44 nymphs collected in a cotton field near a farm house were all infected, as were 2 adults found in another locality. From studies similar to those made in connection with *T. gerstaeckeri*, Stål [*R.A.E.*, B **28** 57], it is concluded that the trypanosomes were *Trypanosoma cruzi*.

Chigger Mites.—*Publ. Hlth Rep.* **55** no. 29 pp. 1312–1314, 7 refs. Washington, D.C., 1940.

The name chigger mite is generally used in the United States to designate the larval stage of various Trombidiids. Many different species are known to attack vertebrates, but only two have been recognised as attacking man in that country, the common North American chigger*, which is widely distributed and occurs from Long Island to Mexico and from the Atlantic coast to the Rocky Mountains, and a closely related form found in the northern part of the Mississippi Valley. The larva and adult of the common species are briefly described. Although the larva is parasitic, the adults are scavengers and live largely on the faecal matter of Arthropods and on woody decaying substances. Eggs are laid in the ground, and the larvae hatch in spring soon after the warm weather begins. They have been found in low-lying land and well up in the mountains, wherever there is rough growth of weeds and shrubbery. They may occur from the latter part of April until the end of October, depending on conditions of temperature and moisture. In the southern States, they may begin to cause annoyance early in May, whereas in the northern part of their range they seldom appear before the middle of June. They are not only a pest of man but have also been reported as attacking a wide range of vertebrates, including domestic animals, small mammals, birds and reptiles. They are an important pest of poultry and frequently cause the death of young chickens.

The larvae attach themselves to the surface of the skin and apparently feed on the epidermal tissue liquefied by a secretion that they inject into the skin. They are too large to enter the pores, but frequently

* It is stated in a foot-note that the correct name for the common species is *Leptus rileyi*, Oudemans (1939), of which *Trombicula cinnabaris*, Ewing (1920), and *L. similis*, Hirst (1921) are synonyms, and that it is the mite called *T. alfreddugèsi*, Oudm., by Ewing [*cf. R.A.E.*, B **27** 5], but the reasons for this synonymy are not given and there is no reference in the bibliography to any paper published later than 1938. Oudemans in proposing the name *L. rileyi* [*Zool. Anz.* **127** 80] made no comment on the possible existence of an earlier available name.—Ed.

attach themselves at the mouth of hair follicles. The site of attack is said to be determined by the tightness of the clothing at certain parts of the body and the thinness of the skin. Although they are widely believed to burrow into the skin and embed their entire body, such a method of attack must be extremely uncommon, as they would be unable to do this except in instances where a large enough opening in the skin was already present. The symptoms produced in man are briefly described.

Application of kerosene or 95 per cent. alcohol will kill the larvae. As soon as possible after exposure, a thick lather of soap should be applied to the affected parts and allowed to remain for 10 minutes or more before bathing. Even though the larvae may be removed or killed soon after attachment, enough secretion has usually been introduced to cause the characteristic itching. For this there is no known specific remedy, although the irritation may be temporarily relieved by the application of ammonia, strong salt water or a calomel phenol lotion. Collodion with metaphen applied to the lesions is recommended both to relieve irritation and to prevent secondary infection. When it is necessary in summer and early autumn to go into fields of tall weeds or grass, or wherever there is heavy undergrowth, stockings and underclothing should be liberally sprinkled with flowers of sulphur to prevent attack.

SHUTE (P. G.). **Failure to infect English Specimens of** *Anopheles maculipennis* **var.** *atroparvus* **with certain Strains of** *Plasmodium falciparum* **of Tropical Origin.**—*J. trop. Med. Hyg.* **43** no. 13 pp. 175–178, 10 refs. London, 1940.

When mosquito-transmitted malaria was first used for therapeutic purposes in England, females of *Anopheles maculipennis* var. *atroparvus*, van Thiel, of local origin were employed for routine transmission of *Plasmodium vivax*. No difficulty was experienced in infecting them, although strains of the parasite from the temperate zone and from the tropics were used. After about five years, it was decided to try experimental infections with other species of *Plasmodium*, and seven batches of *atroparvus* were fed on a patient infected with an Indian strain of *P. falciparum* The mosquitos were fed when the gametocytes were numerous and the male gametocytes exflagellated freely [*cf. R.A.E.*, B **19** 118; **26** 227], and were dissected at periods from the fourth to the tenth day after feeding, but in none of them was any oöcyst formation found. The results of trials with other patients infected with the same strain of parasite were also all negative. As it was thought that the temperature at which the mosquitos were kept (25°C. [77°F.]) might be too low for *P. falciparum*, further experiments were carried out at a constant temperature of 30°C. [86°F.], but again no instance of infection could be found.

These results suggested that, under the conditions of the experiment, *A. m. atroparvus* could not transmit *P. falciparum*. However, as it does so in nature in the Mediterranean region, further attempts were made to obtain experimental transmission with a strain of *P. falciparum* from Europe. Accordingly, mosquitos of the English strain were taken to Rome and fed on two Italian patients whose blood contained numerous *falciparum* gametocytes. When the Anophelines were dissected a few days later, about 50 per cent. of both lots showed oöcyst infection. Other batches fed on patients from Italy and Sardinia,

respectively, later transmitted *P. falciparum* to patients in England, and other mosquitos fed on these patients also transmitted the infection. Similar results were later obtained with two strains of *P. falciparum* from Rumania.

A few attempts were made to infect *A. m. atroparvus* with a strain of *P. falciparum* from West Africa and one from East Africa. All the results were negative, but as the gametocyte prevalence was never high, they were not considered conclusive, though it was thought that they might indicate that the English *atroparvus* was incapable of transmitting strains of *P. falciparum* of tropical origin. However, though it had been proved that the male gametocytes were mature in the Indian and African strains, there was no information about the ripeness of the female forms, which would be proved, in the presence of mature male gametocytes, by the formation of oökinetes in the ingested blood in the mosquito's stomach. Further experiments were therefore made in which 310 mosquitos were given single or multiple feeds on patients infected with a West African strain of *P. falciparum*, which was shown by the exflagellation of the male gametocytes and the formation of oökinetes to be potentially infective. In no case could oöcysts be found, whether the mosquitos were kept at 24 or 34°C. [75·2 or 93·2°F.]. The gametocyte prevalence in the peripheral blood of the patients on whom the mosquitos were unsuccessfully fed was many times greater than that given by other authors as the lower limit of infections [**18** 193; **23** 284].

The results of these experiments indicate that the English *atroparvus* failed to become infected because it is not a suitable carrier of some, at least, of the tropical strains of *P. falciparum*. It would therefore appear that persons carrying gametocytes of *P. falciparum* of tropical origin would be unlikely to cause an outbreak of fresh cases of malaria in England through the agency of English *atroparvus*. On the other hand, the four English Anophelines readily become infected when fed on tropical strains of *P. vivax* and the English *atroparvus* is a very efficient carrier of *P. ovale*, which, so far as is known, is confined to tropical Africa.

MORGAN (E.). **The Tropical Grass *Melinis minutiflora* as a Preventative against Malaria and other Tropical Diseases.**—*J. trop. Med. Hyg.* **43** no. 13 p. 179. London, 1940.

It is recommended that Gordura grass, *Melinis minutiflora*, should be planted round all dwelling houses in Venezuela, as a protection against malaria and tick-borne diseases of animals, as mosquitos are almost completely absent from pastures planted with this grass as long as it is in the green stage, and cattle covered with ticks when entering such pastures become free after a few weeks [*cf. R.A.E.*, B **23** 214]. The grass, which is rich in protein, and therefore is extensively planted for fattening animals, is rather coarse for sheep, but suitable for cattle, horses and mules. Although generally used for pasture, it can also be cut for fodder. It cannot be grown on swampy ground, but thrives on arid soil. It has a peculiar penetrating odour and contains an oily substance, which probably accounts for its " anti-verminous " effects. At the height of the dry season on exceptionally arid soil, the stems may get dry and a good deal of the oily contents disappear, in which case some pests, particularly ticks, may be found in the pasture.

HU (S. M. K.). **Studies on the Susceptibility of Shanghai Mosquitos to experimental Infection with** *Wuchereria bancrofti* **Cobbold. IX.** *Anopheles hyrcanus* **var.** *sinensis* **Wiedemann.**—*Peking nat. Hist. Bull.* **14** pt. 2 pp. 83–97, 10 refs. Peiping, 1939. [Recd. 1940.]

During 1933–35 and 1937, experiments similar to those already noticed [*R.A.E.*, B **28** 65, etc.] were undertaken in Shanghai to determine the susceptibility to infection with *Filaria* (*Wuchereria*) *bancrofti* of females of *Anopheles hyrcanus* var. *sinensis*, Wied., reared from larvae collected locally. Filarial larvae were found in only 1 out of 53 examples fed on a case of light infection with *F. bancrofti* in 1933 and dissected 3–19 days later ; it had 2 infective larvae in the thorax. In each of three experiments, in which females of *Culex pipiens* var. *pallens*, Coq., were also fed on the same case, some of them were positive. Of 441 females of *A. h. sinensis* fed on a case of heavy filarial infection, 60 were dissected before the filarial larvae in them had time to complete their development. Of these, 34 were negative. Of the 381 dissected after time had been allowed for the filarial larvae to complete their development to the infective stage, 147 were negative, 120 harboured only dead first-stage larvae that had undergone complete chitinous encapsulation, and 80 harboured infective larvae, the average number per mosquito being 3·6. Of the 78 that were alive at the time of dissection, 51 contained living infective larvae and 3 others both living and dead ones. When examples of *Culex pipiens* var. *pallens* and *C. vagans*, Wied., were fed on the same filarial case at the same time as some of the Anophelines, they showed a higher percentage positive for infective larvae, a larger proportion of the infective larvae alive and a larger number of infective larvae per mosquito. In 1933, 245 females of *C. p. pallens* and 87 of *A. h. sinensis* were collected at the same time from a house in Woosung in which there were persons infected with *F. bancrofti*, and filarial larvae were found in 42 of the former [**22** 104] and 4 of the latter.

VAN HOOF (L.). **Rapport sur l'hygiène publique au Congo belge pendant l'année 1938.**—125 pp. multigraph, 3 fldg maps, 1 fig. [Brussels, 1939.] [Recd. 1940.]

Until 1937, there was only one focus of plague in man in the Belgian Congo. This was to the west of Lake Albert [*R.A.E.*, B **25** 212 ; **26** 255] and slightly overlapped the area affected by rodent plague. The existence of this focus was definitely proved in 1929 [**25** 212], since when the extent of the rodent enzootic has been determined. It was concluded in 1937 that the latter was likely to extend towards the mining region to the west of the Great Lakes of the south, and it appears to have done so in May 1938 and to have been the cause of a few cases of plague in man in the region of Butembo to the west of Lake Edward.

A table is given showing the monthly incidence of plague in man in the focus to the west of Lake Albert for the years 1928–38, inclusive. In 1938, there were 19 cases, 17 of which were fatal. The flea infesting man in this region is *Ctenocephalides* (*Ctenocephalus*) *canis*, Curt. Strains of plague were isolated from individuals of *Ctenocephalides* taken on man and others from some taken in the dust of native huts. *Xenopsylla cheopis*, Roths., and *X. brasiliensis*, Baker, are rarely taken on man, but *Tunga* (*Sarcopsylla*) [*penetrans*, Westw.] is abundant.

The flea-index of *Mastomys coucha* var. *ugandae* was low, but 96 per cent. of the fleas on it belonged to the genus *Xenopsylla*. On wild rodents, *Dinopsyllus* and *Ctenophthalmus* were predominant. *Xenopsylla* was the most frequently taken in the dust of huts, and a strain of plague bacilli was isolated from a batch of *X. brasiliensis* taken in a hut in which were some sick persons. Strains of plague were also isolated from man, *Mastomys*, and 5 less numerous species of rodents and from the fleas, *X. cheopis*, *T. penetrans* and *Ctenophthalmus*.

In the new focus near Lake Edward, there were 7 proved cases of plague, all fatal. A campaign against the rodents round the two villages concerned revealed the presence of 9 species, of which the most abundant were *M. coucha* var. *ugandae* (32 per cent.), *Mus* (*Rattus*) *rattus alexandrinus* (52 per cent.) and *Arvicanthis abyssinicus* (14 per cent.). The rodent fauna differs from that of Lake Albert in the abundance of *M. r. alexandrinus*, which is thought probably to have been recently introduced. A strain of plague was isolated from this species. On the 16,870 rodents caught and identified, 9,340 fleas were taken, of which 8,477 were *X. brasiliensis*. Two strains were isolated from fleas in the neighbourhood of one of the villages. *X. cheopis* appeared to be completely absent, and it is thought that this may be the cause of the limited extent of the disease in the new focus. In the course of an anti-plague campaign, 208,909 rodents were killed, and the average number per hut was reduced from 4–10 to less than 1, at which point it is becoming stabilised. The last case of plague in man was reported on 24th June 1938, and strains were last isolated from rodents and fleas in September.

Uganda. Annual Report of the Medical Department, 1939.—Med. 8vo, 56 pp. Entebbe, 1940. Price 2*s*.

In the course of the Laboratory Report (pp. 49–50), it is stated that the Senior Entomologist (Medical) carried out rat and flea surveys in various districts in Uganda. He concludes from these and former surveys [*R.A.E.*, B **28** 26] that *Xenopsylla cheopis*, Roths., is the dominant flea on both hut and field rats in the areas of the Protectorate so far free from plague, whereas in the areas where plague is endemic, it is dominant in townships only and *X. brasiliensis*, Baker, is the common flea in the districts. An investigation to ascertain the species of flies frequenting ulcers and wounds revealed that 95 per cent. are *Musca sorbens*, Wied., the principal breeding medium of which was found to be human faeces.

Lamborn (W. A.). **Annual Report of the Medical Entomologist for 1939.**—*Annu. med. sanit. Rep. Nyasaland 1939* pp. 26–31. Zomba, 1940.

For a period of rather more than two months, the author carried out a survey for cases of sleeping sickness in that part of the Kota Kota district of Nyasaland south of the road from Kota Kota to Kasungu. From a study of the topographical distribution of *Glossina* [*morsitans*, Westw.] in relation to population, he concluded that a major epidemic would be extremely unlikely, for, owing to the poverty of the soil over most of the area, the population is concentrated along the edge of the Lake and in the broad open stretches of country bordering the rivers

in the south, where conditions are suitable for cultivation, and these are not the normal habitats of the fly. On the other hand, a minor epidemic might easily occur among the people living actually within the fly area, for the villages there are small, the clearings are ineffective against the fly, and the gardens are at a distance from the villages; moreover, the chances of infection are further increased by the abundance of game animals from which it would seem that the fly has been deriving the infective strain of trypanosome. The recommendations made include the settlement of the population in larger communities with effective clearings, the prohibition of the removal of villages, unless the new site is outside the fly zone, and the suspension of the game laws over the southern part of the district (a game reserve exists in the north). It is also suggested that the southern boundary of the game reserve be moved to the north of the road from Kota Kota to the west, since it is probable that flies are carried into the settlement in cars or on the backs of natives. The occurrence of isolated cases of sleeping sickness in villages outside the fly area seems to preclude the possibility of man-to-man infections, but the incidence of such cases over a wide area and over a long period of time is readily explicable if it is assumed that *Trypanosoma rhodesiense* has here become a parasite of animals, in which, as shown by Corson [*cf.* *R.A.E.*, B **27** 19], it may retain its infectivity for man for several years, and perhaps indefinitely.

In the course of an investigation of the prevalence of bubonic plague in domestic and field rodents in and near a village in the southern part of Nyasaland where three cases had been discovered in man, an example of *Mastomys coucha* that had recently died proved to be infected. This mouse is the principal intermediary in the spread of plague between domestic and field rodents in South Africa. The ectoparasites obtained from the rodents included *Xenopsylla brasiliensis*, Baker, on domestic rats and *M. coucha*, and *X. brasiliensis* and *X. syngenis*, Jord., on other rodents.

An account is given of a few of the 39 experiments carried out to test the ability of the cockroaches, *Blatta* (*Periplaneta*) *orientalis*, L., and *Nauphoeta cinerea*, Ol., both of which are abundant in Nyasaland, to transmit the bacilli of leprosy by contaminating human food after feeding on leprous material. The insects were allowed to feed on dressings of lint that had been applied to leprous sores or on leprous crusts and their faeces examined at intervals. Cockroaches used as controls were given the same food as the experimental ones except that no leprous material was supplied. Reasons for believing that organisms found in the faeces of the experimental insects of both species were leprosy bacilli are given at some length. Attempts were made to confirm the supposition by inoculating faeces and other material from cockroaches that had had access to leprous material into rats, but no results have so far been obtained. If, however, as experiments by Uchida indicate, the incubation period in rats is as much as 6 months, no results could have been expected at the time of writing.

Proof that tubercle bacilli can remain viable in *Musca sorbens*, Wied., for over a week [*cf.* **28** 107–108] was afforded by an experiment in which a guineapig that had received an intraperitoneal injection of the gut contents of 3 examples that had fed on tubercular sputum 8 days previously succumbed 4 months later to a generalised infection,

particularly of liver and spleen. The animal used in a similar experiment in which the injection was made 5 days after the infecting meal also died from the same cause.

Anophelines of the series of *Anopheles funestus*, Giles, collected in July in the middle of the dry season, all proved to be the type form. Their distribution in the four wing groups is shown [*cf.* **28** 198].

Studies of the Rickettsias of the Typhus-Rocky-Mountain-Spotted-Fever Group in South Africa.

ALEXANDER (R. A.), MASON (J. H.) & NEITZ (W. O.). **I. Isolation of Strains.**—*Onderstepoort J.* **13** no. 1–2 pp. 19–23. Pretoria, 1940.

ALEXANDER (R. A.) & MASON (J. H.). **II. Morphology and Cultivation.**—*T.c.* pp. 25–39, 1 chart, 10 figs.

MASON (J. H.) & ALEXANDER (R. A.). **III. The Disease in the Experimental Animal. Cross-immunity Tests.**—*T.c.* pp. 41–65, 7 charts. **IV. Discussion and Classification.**—*T.c.* pp. 67–76, 34 refs.

In the first paper, details are given of the origin and methods of isolation of five strains of rickettsiae: strain "Appleton" from a dog, strain "hare" from *Hyalomma impressum*, Koch, collected from a hare (*Lepus sexatilis*), strain "Robertson" (tick-bite fever) from man and rat typhus from a rat, all of South African origin, and Marseilles fever from *Rhipicephalus sanguineus*, Latr., collected from dogs in Tunis. In the second paper, the microscopic appearance of the scrotal exudate in guineapigs infected with each of the five strains and the technique of cultivation on the chorio-allantoic membrane of the chick embryo are described.

The cross-immunity experiments in guineapigs described in the third paper showed that the five typhus strains might be arranged in two groups: rat-typhus, which immunised against itself and to a great extent against the other four, and "hare," tick-bite fever, "Appleton" and Marseilles fever, which gave almost complete reciprocal cross-immunity, but did not immunise against rat-typhus.

In the fourth paper, the findings reported in the other three are summarised with a view to classifying the diseases on the basis of the criteria outlined by Pinkerton [*R.A.E.*, B **24** 154]. It is concluded that endemic, murine or rat typhus falls into the typhus group, and Marseilles fever and the "Robertson," "Appleton" and "hare" strains into the Rocky Mountain spotted fever group. A proposed nomenclature is discussed. It is suggested that the name *Rickettsia prowazeki* var. *mooseri* be retained for the causal agent of South African endemic typhus, and that the name *Dermacentroxenus rickettsi* var. *pijperi*, n., be given to the causal agent of South African tick-bite fever. If this nomenclature is adopted, certain additional modifications become necessary. The name *D. rickettsi* var. *conori* [*cf.* **20** 244] should be given to the rickettsia causing Marseilles fever, and the generic name *Rickettsia* would not be permissible for *Rickettsia ruminantium*, *R. bovis*, *R. ovina* or *R. canis*, although the general names "rickettsia" and "rickettsiosis" might be retained, since all belong to the family Rickettsiaceae. These latter rickettsiae differ so markedly morphologically and biologically from those of the typhus and spotted fever groups that the separation is merited, but no generic name is suggested pending the completion of adequate comparative studies.

Schulz (K.). **A Rickettsiosis new to South Africa.**—*Onderstepoort J.* **13** no. 1–2 pp. 287–289, 1 fig., 1 ref. Pretoria, 1940.

The object of this preliminary note is to record the occurrence of *Rickettsia ovina* [*cf.* *R.A.E.*, B **24** 157] in the monocytes in blood, intima and lung smears of sheep received during January 1939 from District Grootfontein, South-West Africa. The disease it caused was always fatal in a few hours and was responsible for heavy losses among sheep on the farm concerned over a period of about 12 months, but cattle and goats were not affected. Nutritional disturbances and infestation by ticks and parasitic worms were thought to be contributory causes to the high mortality. Blue ticks [*Boophilus annulatus decoloratus*, Koch] and bontleg ticks [*Hyalomma impressum*, Koch] were numerous on the sheep, but none of the ticks that transmit *Rickettsia ruminantium* could be found. The sheep were examined for *R. ruminantium* (from which *R. ovina* can easily be differentiated as it occurs exclusively in the monocytes and is often abundant in the peripheral circulation), but the result was negative.

R. ovina has also been found in a blood smear from a sheep from the Transvaal.

Quittek (G.). **Die Aussenschmarotzer der Tauben.** [External Parasites of Pigeons.]—*Z. Brieftaubenk.* 1939 nos. 16, 17, 23 repr. 3 pp. each, ill. Hannover-Linden, 1939. [Recd. 1940.] **Duetaegen.** [The Pigeon Tick.]—*Brevduen* 1939 no. 11 repr. 3 pp., ill. Copenhagen, 1939. [Recd. 1940.]

An account is given in the first paper of the external parasites of pigeons in Germany and of the injury that they cause to the birds. Mallophaga are the most widely distributed, and *Columbicola columbae*, L., is the commonest of them. Its complete life-cycle lasts about 5 weeks. The eggs are laid on the quills, and the presence of large numbers of them and the loss of plumage due to feeding by the parasites seriously impair the flying power of carrier pigeons. For the control of Mallophaga, sodium fluosilicate should be dusted on the feathers or used in a 5 per cent. solution for bathing the birds. Derris dusts have also given good results.

The pigeon tick, *Argas reflexus*, F., for which the author uses the name *A. columbarum*, Shaw, is the most important ectoparasite. It occurs chiefly in pigeon lofts in which cracks and grooves afford it shelter. Recent investigations in Berlin have shown that it requires about 3 years for development, and that the adults can survive, even without food, for several years. Females lay about 50 eggs soon after pairing, and continue to oviposit at intervals, mostly during the summer. The larvae hatch in 1–2 months and seek a host, on which they engorge for 7–9 days. They then seek shelter in cracks and transform into nymphs some months later. The nymphs moult four times before reaching the adult stage, and engorge before each moult. Adults of both sexes engorge on the pigeon prior to pairing. The irritation resulting from the bite and the loss of blood are injurious to the pigeons, especially the very young birds. To combat an existing infestation all cracks, etc., must be sealed. The ticks are resistant to lime-wash and insecticides and should be eradicated by means of a blow-lamp, where this is possible. Moveable fitments should be treated with boiling water. Perches should be placed away from walls and should stand in pans filled with

oil. A strip of fly-paper should be placed along the walls to prevent the larvae from climbing up and then dropping on to the birds. Infested birds can be freed by being caged for 10–14 days on a smooth surface surrounded by a band of fly-paper to trap the larvae when they leave them and seek shelter for moulting. New birds or birds that have been exhibited should be quarantined for 14 days unless known to be free from ticks.

Of the mites that infest pigeons, *Dermanyssus gallinae*, DeG., is very common and impoverishes the blood of the birds. The measures recommended against *A. reflexus* are also effective against it, but it is easier to eradicate. Its presence is soon noticed as it also attacks man. Other mites that attack pigeons are *Cnemidocoptes* spp., *Falculifer rostratus*, Buchholz, and *Syringophilus bipectinatus*, Heller, as well as two species that are not ectoparasites, and are seldom of importance. These are *Laminosioptes cysticola*, Vizioli, which occurs in the skin, and *Cytoleichus* (*Cytodites*) *nudus*, Vizioli, which infests the lungs of the pigeons. No method of controlling the latter is known, and in cases oi infestation all the birds that may be affected should be killed.

The second paper is a translation of the section of the first one dealing with *A. reflexus*.

[Maksianovich (M. I.).] **Максианович (М. И.). Le venin du karakourte** *Lathrodectus 13-guttatus* **agissant comme antigène ; effectivité de l'antitoxine dans les expériences sur les animaux.** [*In Russian.*]—*Med. Parasitol.* **8** no. 6 pp. 51–64, 3 figs. Moscow, 1939. (With a Summary in French.) [Recd. 1940.]

Latrodectus tredecimguttatus, Rossi, occurs in many districts in southern Russia, but is commonest in Central Asia, where men have been killed by its bites [*cf. R.A.E.*, B **23** 76]. The properties of its venom are discussed, and an account is given of investigations on the effect on laboratory animals of that of sexually mature, fertilised females. The symptoms produced by injection of an emulsion of the fresh poison glands resembled those following bites, but an emulsion prepared from dried glands was less toxic. In experiments on the possibility of neutralising the venom, 10–20 glands in 1 cc. normal saline were kept for one hour on ice ; the toxicity of these extracts was tested on rabbits and mice, from 0·1 to 0·5 per cent. formalin was added to them and they were then kept for 6–15 days at a constant temperature of 35, 36 or 37°C. [95, 96·8 or 98·6°F.]. Tests on laboratory animals showed that the toxicity of the extracts was completely destroyed by the addition of 0·1 per cent. formalin and storage for 7 days at 36–37°C. A thick emulsion that was prepared from ground dried glands in normal saline and was diluted to a concentration of 1 : 1,000 was rendered innocuous by the addition of 0·5 per cent. formalin and storage at a constant high temperature for 15 days. Rabbits that received 2–3 intravenous injections of these preparations became fully resistant to a dose of the poison that killed an untreated rabbit in 5 minutes, and one treated with the emulsion of dried glands was not affected by the bites of 7 spiders, whereas the control animal died in a few hours after the bite of only 3. The effectiveness of the preparations was not reduced by storage for a year in a cool place.

The immunisation of a horse to obtain an antitoxic serum is described. The process lasted three months. After repeated subcutaneous injection of extracts of the fresh glands of the spider, the

horse was not affected by the bites of 100 spiders applied to it at the rate of 30–40 at a time over a period of three days. Guineapigs survived bites of the spiders when the serum was injected subcutaneously into them before or shortly after they were bitten. The author therefore suggests that the serum should be used for the treatment of bites in man.

[SERGEEVA (Z. D.).] **Сергеева (З. Д.). Species of Animals on which fed *Anopheles maculipennis* in Districts of White Russia (BSSR).** [*In Russian.*]—*Med. Parasitol.* **8** no. 6 pp. 89–90. Moscow, 1939. [Recd. 1940.]

In the course of investigations on malaria in the most severely infected districts in the southern part of the Province of White Russia in 1935, collections of *Anopheles maculipennis*, Mg., were made in inhabited houses and animal quarters in villages situated on the river Pripyat'. The larvae were found in abundance in lakes formed in the low-lying flooded area at a distance of about 3 miles from the villages and in smaller numbers in pools on the outskirts. Precipitin tests showed that the great majority of the females taken in animal quarters had fed on animals and hardly any on man. Of those taken in inhabited houses, 13·6 per cent. had fed on man and the others on various animals (chiefly cows and pigs).

[GORITZKAYA (V. V.).] **Горицкая (В. В). Un cas d'infection spontanée par les plasmodes de l'*Anopheles hyrcanus* Pall. provenant de la région de Dniépropétrovsk.** [*In Russian.*]—*Med. Parasitol.* **8** no. 6 p. 91. Moscow, 1939. [Recd. 1940.]

Observations in the autumn of 1938 on Anophelines in a village on the upper delta on the Dnieper (Province of Dniepropetrovsk), showed that *Anopheles maculipennis*, Mg., which predominated in the village, and *A. hyrcanus*, Pall., occurred in abundance. The latter is fairly widely, but unevenly, distributed in the Province and breeds in rice-fields, lakes and shallow rivers overgrown with *Phragmites*, *Scirpus* and *Carex*. It was seldom found in houses, which it entered to feed and left before digesting its blood-meal. During the day it sheltered in the dense growth of *Scirpus* and *Carex* in parts of the delta that had dried up during the summer, but in which the soil was still moist. Of 318 females taken in the delta at a distance of about 200 yards from dwellings between 13th August and 13th September, one harboured sporozoites in the salivary glands. In view, however, of the comparatively infrequent contact of *A. hyrcanus* with man and the short duration of its life [*cf. R.A.E.*, B **27** 71], its importance as a vector of malaria in the Province must be small. The rate of infection of *A. maculipennis* in the same locality was 3·2 per cent.

[ANISIMOVA (M. M.).] **Анисимова (М. М.). Sous-espèces de l'*Anopheles maculipennis* au chemin de fer d'Orenbourg.** [*In Russian.*]—*Med. Parasitol.* **8** no. 6 p. 93. Moscow, 1939. [Recd. 1940.]

In the summer of 1937, batches of eggs of *Anopheles maculipennis*, Mg., race *messeae*, Flni., were collected in five localities along the

railway between Orenburg and Samara, and in the town of Aktyubinsk (south-east of Orenburg). Eggs of *A. maculipennis* race *sacharovi*, Favr, were found in a locality south of Kazalinsk, on the lower Suir-Dar'ya.

[Osins'kiĭ (S. O.).] **Осінський (С. О.). The Rôle of Insects that attack Carcasses in the Preservation and Spread of the Bacilli of Anthrax in Nature.** [*In Ukrainian.*]—*Actes sci. Inst. vét. Kiev* **1** no. 1 pp. 50 58. Kiev, 1938. (With a Summary in Russian.) [Recd. 1940.]

Since anthrax is usually contracted *per os* owing to the presence of the spores of the bacillus in the upper layers of the soil or on fodder crops, and as the carcasses of animals that have died from the disease are often partly or completely destroyed by insects, field and laboratory observations were carried out near Kiev in 1936 to determine the extent to which insects may be responsible for introducing the bacilli into the soil. When a dead rabbit was left on the ground, flies of the genera *Calliphora, Lucilia* and *Sarcophaga* arrived almost immediately and sucked fluids from the carcass, while the beetles, *Necrophorus vespillo*, L., *Silpha obscura*, L., and *S. atrata*, L., appeared in about an hour and fed on it.

Beetles of these three species that were deprived of food for 3–4 days and then confined with the carcass and some internal organs of a mouse that had died of anthrax ingested pieces of the flesh. When the beetles were transferred immediately after feeding to dishes containing meat-peptone agar, on which they crawled and cleaned themselves, colonies of anthrax bacilli subsequently appeared on the agar. When the beetles were kept in a cage for 1–2 hours before transference to the dishes, however, few or no bacilli developed on the agar, from which it is concluded that some of them perished while still on the legs of the beetles and some passed into the soil in the cage. Colonies of anthrax bacilli were also obtained from the alimentary tract of beetles that had fed on infective material. The bacilli were most abundant on the first day after the infective feed ; only a few occurred on subsequent days and practically none on the eighth. They were also present in cultures of material from infected beetles after it had been heated for 10 hours at 80°C. [176°F.]. The virulence of the bacilli was not reduced by passage through the beetles, as a rabbit artificially infected with 0·2 cc. of a broth culture died in 40 hours.

In experiments with the flies of the genera *Calliphora, Lucilia* and *Sarcophaga*, the technique of which is described, adults that had sucked the juices of small pieces of the organs of a diseased laboratory animal deposited anthrax bacilli on the agar on which they were subsequently placed and which they also sucked. Numerous colonies of the bacilli were also obtained from the alimentary tract of the flies, and a rabbit artificially infected with 0·2 cc. of a broth culture of the tract died of anthrax in 56 hours.

On the basis of these observations, the author concludes that insects are an important factor in the dissemination of the bacilli, and recommends that carcasses that cannot be disposed of immediately should be sprayed with a repellent, such as kerosene or creolin.

[VOROBÏOV (M. M.).] **Воробйов (M. M.). Description of the Morphology and Biology of the Mange Mite of white Mice** *Listophorus larisi* **n. sp.** [*In Ukrainian.*]—*Actes sci. Inst. vét. Kiev* **1** no. 1 pp. 151–157, 7 figs. Kiev, 1938. (With a Summary in Russian.) [Recd. 1940.]

Detailed descriptions are given of all stages of *Listophorus larisi*, sp. n., a mange mite found in November 1935 infesting white mice in the Veterinary Institute in Kiev. The female deposits 2–3 eggs at a time and fixes them with an adhesive substance to the hairs in the fur. The eggs hatch in 6 days. *L. larisi* is apparently specific to mice, and did not infest guineapigs, rabbits or white rats.

VARGAS (L.). **Nuevas observaciones sobre** *Anopheles* **mexicanos.** [New Observations on Mexican Species of *Anopheles.*]—*Ciencia* **1** no. 6 pp. 256–258, 2 figs., 7 refs. Mexico, D.F., 1940.

In April 1940, larvae of *Anopheles hectoris*, Mira, were collected, for the first time in Mexico, in the State of Chiapas, and larvae and males of *A. strodei*, Root, which has not previously been recorded from Mexico, in two localities in the State of Veracruz. Some errors in the author's key to the larvae of the Mexican species of *Anopheles* [*R.A.E.*, B **28** 200] are corrected.

PAPERS NOTICED BY TITLE ONLY.

Plague Infection in Lice from a Marmot [*Marmota flaviventris*] **in Park County, Wyo.**—*Publ. Hlth Rep.* **55** no. 29 p. 1321. Washington, D.C., 1940.

HASSALL (A.), DOSS (M. A.), TAYLOR (R. M.), CARSON (G. B.) & BERO (D.). **Index-catalogue of Medical and Veterinary Zoology Part 4. Authors: D to Džunkovski.**—pp. 963–1176. Washington, D.C., U.S. Dep. Agric., 1940. Price 30 *cts.* (from Supt. Documents). [*Cf. R.A.E.*, B **27** 192.]

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* For relation to disease, see under *Aegyptianella*, Blackwater Fever, Filariasis, Leprosy, Malaria, *Spirochaeta anserina*, *Trypanosoma congolense*, Virus Diseases, Yellow Fever.

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